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PRELIMINARY GUIDE TO WETLANDS OF THE WEST COAST STATES. MAJOR A--ETC(U)
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TECHNICAL REPORT Y-78-4

PRELIMINARY GUIDE TO WETLANDS OF THE WEST COAST STATES

Major Associations and Communities Identified

Environmental Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

April 1978
Final Report

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

PRELIMINARY GUIDE TO WETLANDS

Major Associations and Communities Identified

Technical Report No.	Region
Y-78-2	Peninsular Florida
Y-78-3	Puerto Rico
Y-78-4	West Coast States
Y-78-5	Gulf Coastal Plain
Y-78-6	Interior-Great Lakes
Y-78-7	South Atlantic States
Y-78-8	North Atlantic States
Y-78-9	Alaska

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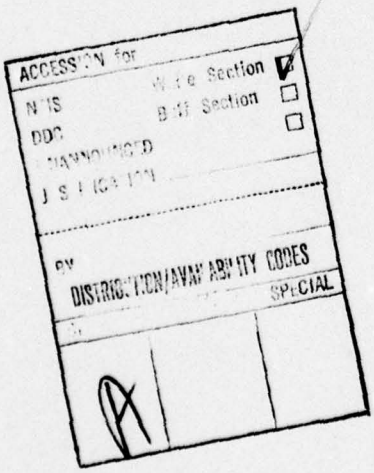
15 May 1978

SUBJECT: Transmittal of Technical Report Y-78-4

TO: All Report Recipients

1. The report transmitted herewith provides preliminary guidance on wetland determination to Corps of Engineers personnel responsible for the implementation of Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) in the West Coast States. This guide, sponsored by the Office, Chief of Engineers, represents one of a series of eight guides to the major wetland associations of the United States. Other guides include peninsular Florida, Puerto Rico, Alaska, South Atlantic States, Gulf Coastal Plain, North Atlantic States, and Interior-Great Lakes.

2. This guide is intended to assist in the field recognition of major wetland communities as they relate to the determination of jurisdictional boundaries in the implementation of the Section 404 permit program. It is neither a regional flora manual nor a general classification system. Several manuals that identify the flora of the West Coast States are referenced in this document and personnel requiring species identification are referred to those works. Personnel requiring a detailed wetland classification system may wish to consult "Classification of Wetland and Deep-Water Habitats of the United States (an operational draft)," prepared by the National Wetland Inventory Project of 1975-79 of the U. S. Fish and Wildlife Service.



JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

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This guide to the major plant associations and communities found in wetlands within the West Coast States is one of a series of eight such guides, each prepared by a specialist or specialists familiar with the wetlands in the region covered by the guide. The guides are intended for distribution to the various U. S. Army Engineer Districts for use in wetland identification in the implementation of Section 404 of the Federal Water Pollution Control Act Amendments of 1972. The classification system in the guide is intended solely for use in the Section 404 permit program and is not considered a classification system for other purposes.

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SUMMARY

This report represents one of a series of eight preliminary guides to the dominant plant associations and communities found in the major wetlands of the United States. The primary purpose of the guidebook is to aid regulatory functions personnel in recognizing and delineating wetlands subject to permit regulation under Section 404 of Public Law 92-500 (Federal Water Pollution Control Act Amendments of 1972).

The guidebook is designed to be self-contained and consists of three parts. An introduction covers the purpose and use of the guidebook as well as general information about Section 404 wetlands. The second part, entitled "Wetlands of the West Coast States," consists of three major sections: Regional Environment, Regional Botanical References, and Wetland Types. The section on regional environment is brief and provides a broad context for the more detailed descriptions of the dominant plant associations and communities found in the major wetlands of the region. Because of synonymy of many scientific names, the nomenclature standard used for the guide is presented in the section on regional botanical references. Detailed description of wetland vegetation is based upon data in the literature and information from scientists having familiarity with the region. The goal of this section is to provide a description sufficiently detailed for field use but not to report minor variations of each wetland. Thus, the descriptions are a compromise between site-specific reports and extremely general discussions. The third part contains references to pertinent publications and Appendices A, B, and C and is specific to the region; a glossary that is common to all guides in the series (Appendix B) was added to aid in the user's clarity of understanding.

PREFACE

At the request of the Office, Chief of Engineers (OCE), the Environmental Laboratory (EL) of the Waterways Experiment Station (WES) initiated production of this report, one of a series of eight preliminary guides to the dominant plant associations and communities found in the country's major wetlands. Other reports in the series apply to peninsular Florida, Alaska, Interior, Gulf Coast, North Atlantic, South Atlantic, and Puerto Rico. The reports are listed on the inside of the front cover. Funding was provided by OCE.

Dr. H. T. Harvey of Harvey, Hartesveldt, Heath, and Stanley, Inc., Santa Clara, California, provided a manuscript for initial construction of the draft guide under Purchase Order No. DACW39-76-M-2475. Mr. Richard H. Daley, Ecologist, Missouri Botanical Gardens, St. Louis, provided major revision and rewriting of the draft copy under Purchase Order No. DACW39-76-M-5173 with the assistance of Mr. Ken Bierly of Montagne-Bierly Associates, Inc., Salem, Oregon, under Purchase Order No. DACW39-77-M-3086. Preparation of the guide was initiated by Dr. Luther F. Holloway, Research Botanist, EL. Dr. Gary E. Tucker, Research Botanist, EL, directed the production of the guide with the assistance of Dr. Robert Terry Huffman, Research Botanist, EL. Ms. Dorothy P. Booth, EL, served as technical editor. The illustration used on the covers of this series of reports was drawn by Ms. Jane Barnes, Russellville, Arkansas.

The guide project was under the general supervision of Dr. H. K. Smith, Project Manager, Habitat Development Project; Dr. C. J. Kirby, Chief, Environmental Resources Division; Dr. Roger T. Saucier, Special Assistant, Dredged Material Research Program; and Dr. John Harrison, Chief, EL.

The Commanders and Directors of WES during the study were COL G. H. Hilt, CE, and COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

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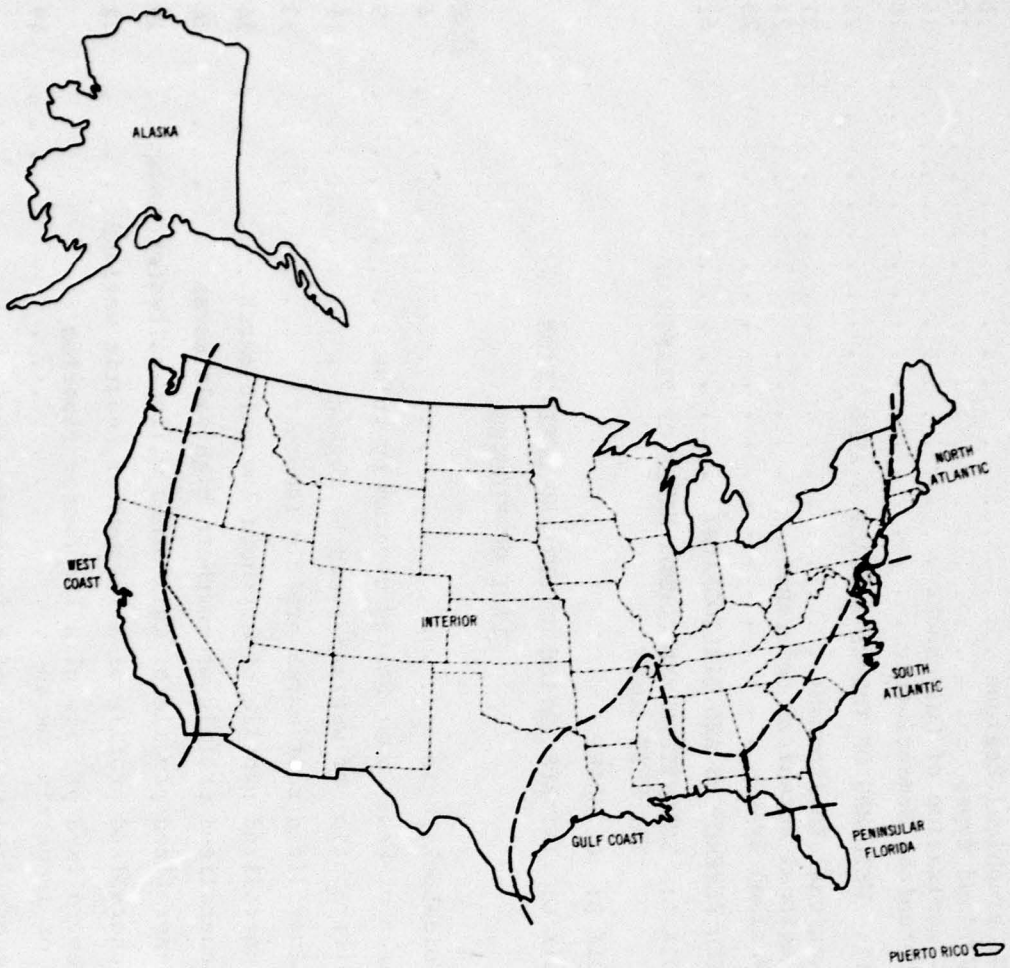

Figure 1. Eight geographical regions defined for the wetland guidebook series

PRELIMINARY GUIDE TO THE WETLANDS OF THE WEST COAST STATES
Major Associations and Communities Identified

PART I: INTRODUCTION

1. This guide to the major plant communities and associations found in wetlands within the West Coast States is one of a series of eight such regional guides, each prepared by a specialist or specialists familiar with the wetlands in the region covered by the guide. Other regional guides include Alaska, Interior, Gulf Coast, North Atlantic, South Atlantic, peninsular Florida, and Puerto Rico (Figure 1). The guides are intended for distribution to the various U. S. Army Engineer District regulatory functions personnel for use in identification of wetlands for the implementation of Section 404 of the Federal Water Pollution Control Act Amendments of 1972. The information provided is intended solely for use in the Section 404 permit program and is not considered a definitive classification system for other purposes.

2. Field personnel having need of a more detailed and definitive system of classification per se should consult one of the several wetland classification systems currently in use in the United States and Canada. The well-known Circular 39 (Shaw and Fredine, 1956) of the U. S. Fish and Wildlife Service has met with widespread use nationally despite its well-documented shortcomings. A recently published operational draft by the Fish and Wildlife Service (Cowardin et al., 1977) represents the most recent product of the National Wetland Inventory Project of 1975-79, an intensive effort that will result ultimately in the publication of a detailed and refined classification system to the wetlands of the entire nation. Numerous regional systems of classification also are available. Among the more significant regional classification systems are those of Golet and Larson (1974), Millar (1976), Odum et al. (1974), Penfound (1952), Stewart and Kantrud (1971), and Zoltai et al. (1975).

Section 404 Permit Program

Authority

3. Under the laws of the United States, Congress has assigned a number of nonmilitary functions to the U. S. Army Corps of Engineers. In addition to the well-known and more traditional roles in flood control, hydropower production, navigation, water supply storage, and recreation, the Corps has responsibility for some activities that are not so well known. Congress has given the Corps of Engineers regulatory responsibility to protect navigation channels and harbors against encroachments and also to preserve and restore water quality by regulating the discharge of dredged or fill material into waterways and wetlands.

4. The primary legislative basis for the Corps' regulatory authority for the disposal of dredged or fill material is the Federal Water Pollution Control Act Amendments of 1972. Section 404 of that Act gives authority to the Secretary of the Army, acting through the Chief of Engineers, to regulate the discharge of dredged or fill material in the waters of the United States.

5. Regulatory authority under Section 404 was initially considered limited to waters that are used presently, were used in the past, or could be used through reasonable improvements to transport interstate commerce. Limitation of the Corps' regulatory authority under Section 404 to navigable waters of the United States was successfully challenged in the District Court for the District of Columbia. On 27 March 1975, the Court ordered the Corps to extend its jurisdictional responsibility for the discharge of dredged or fill material under Section 404 to all waters of the United States (including the territorial seas) and adjacent wetlands and to revise its regulations accordingly.

6. In accordance with the Court's 1975 directive, the Corps of Engineers published an interim regulation in the Federal Register on 25 July 1975. The final set of permit regulations, considerably revised and reorganized, was published in the Federal Register on 19 July 1977.

Scope

7. The Corps of Engineers permit program under Section 404 is extended to many areas that have never been regulated before. In

addition to the navigable waters of tradition, the Corps has been given jurisdictional authority over tributaries to navigable waters, including adjacent wetlands; interstate waters and their tributaries, including adjacent wetlands; and all other waters of the United States, such as lakes and rivers and streams that are not interstate waters or part of a tributary system to navigable waters of the United States; impoundments; perched wetlands; intermittent streams; and prairie potholes, the degradation or destruction of which could affect interstate commerce. In the absence of adjacent wetlands that are a part of the waters described previously, the landward limit of jurisdiction in tidal waters shall be the high tide line and the shoreward limit of jurisdiction in all other waters shall be the ordinary high water mark.

8. The term "wetlands" is a very crucial part of Section 404 and refers to those areas that are inundated or saturated by ground or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (Appendix C).

Purpose

9. The purpose of the Section 404 program, which is a part of the Corps of Engineers' overall regulatory authority, is to ensure that the chemical and biological integrity of waters of the United States is protected from unregulated discharges of dredged or fill material that could permanently alter or destroy the character of these invaluable natural resources.

Importance and Values of Wetlands

10. Wetlands are valuable and productive natural resources of national significance, and some of their major functions include the following:

a. The provision of feeding, cover, and reproduction habitat for a great diversity of species, including endangered and threatened species.

b. The provision of educational, study, refuge and sanctuary, and recreational areas.

c. The maintenance of drainage, salinity, sedimentation, flushing, and current patterns.

d. Cycling of nutrients.

e. Reduction of contaminant loading.

f. Protection from erosion and storm damage.

Geographical Regions

11. Eight geographical regions have been defined for the wetlands guidebook series: Alaska, West Coast, Interior, Gulf Coast, North Atlantic, South Atlantic, peninsular Florida, and Puerto Rico. The geographical regions are based on both physiographic and pragmatic considerations; the boundaries were influenced significantly by the works of Fenneman (1931, 1938). The use of natural units rather than artificial ones, such as political boundaries, minimizes the number of wetland types described in each guidebook. Several states are covered by a combination of two guidebooks, and a very few are covered by three guidebooks. Physiographic parameters were used where possible, since both hydrologic and biotic patterns are related closely to landscape features. Each of the regions will be covered in a separate guidebook. Geographic descriptions for the guides are as follows:

a. Alaska. The state of Alaska is the sole subject of an entire guide. Particular emphasis is placed on coastal wetlands; much of the interior region is "wet", but further study is necessary to determine the exact jurisdictional limits of Section 404.

b. West Coast. This region includes most of California (exclusive of the southeastern part), western Oregon, and western Washington (Figure 2).

c. Interior. The area covered by this region consists of the vast interior of the United States, including much of the Southwest, the Rockies and some of the intermontane region, the Central Plains, and the Midwest. States contained within the region are numerous.

d. Gulf Coast. The Gulf Coast region extends from the coastal plain of Texas to western Georgia. Inland, the coastal plain extends to southern Missouri in the Mississippi embayment; other states included in the region

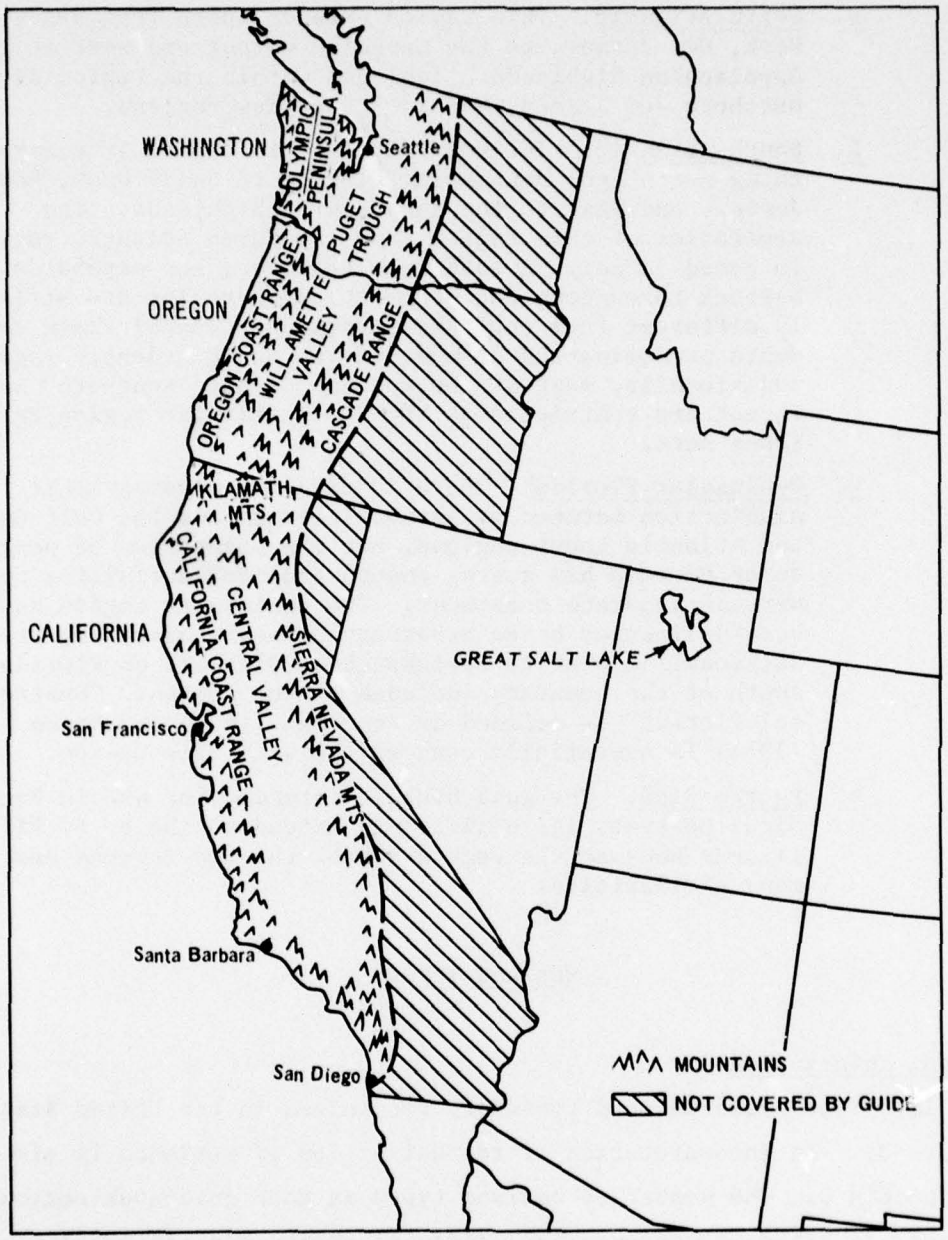

Figure 2. Area of West Coast States covered by guide

are all or parts of Oklahoma, Arkansas, Louisiana, Mississippi, Alabama, Florida, and Tennessee.

e. North Atlantic. This region extends north from Sandy Hook, New Jersey, to the Canadian border and west to the Appalachian highlands. Included within the region is northern New Jersey, New York, and New England.

f. South Atlantic. Included within this region is everything north from peninsular Florida to Sandy Hook, New Jersey, and west to the Appalachian highlands. The separation of this region from the North Atlantic region is based largely on substrate features; the exposures of bedrock throughout the North Atlantic region are strikingly different from the thick mantle of Coastal Plain sediments predominating in most of the South Atlantic region. Additionally, most of the species of the "southern" swamp forest are restricted to the South Atlantic region as defined here.

g. Peninsular Florida. There is no clear physiographic distinction between peninsular Florida and the Gulf Coast and Atlantic Coast regions, but the vegetation of peninsular Florida has strong enough tropical affinities to warrant separate treatment. The peninsular region has been delineated by an arbitrary boundary extending from Jacksonville west to Steinhatchee, with all of Florida south of the boundary included in the region. "Subtropical Florida" as defined by Fenneman (1931) and Braun (1964) is essentially conspecific with this region.

h. Puerto Rico. The guidebook is intended for use in Puerto Rico; however, its utility may extend to the U. S. Virgin Islands because the vegetation of the two regions has many similarities.

Wetland Types

General information

12. Nine basic wetland types are recognized in the United States (Figure 3). An interpretation of the definition of wetlands is given in Appendix C. The number of wetland types in each guidebook region, however, is either seven or eight, since no region has all possible types. The nine basic wetland types have been distinguished by a combination of differences in physiognomy (e.g., marsh versus swamp), growth form (e.g., herbaceous plants versus trees), and environmental factors (such as degree of salinity in soil and water). Terms used on a

	Alaska	West Coast	Interior	Gulf Coast	North Atlantic	South Atlantic	Peninsular Florida	Puerto Rico
Saltwater Aquatic	✓	✓	✓	✓	✓	✓	✓	✓
Saltwater Coastal Flat	✓	✓	x	✓	✓	✓	✓	✓
Saline Inland Flat	x	x	✓	x	x	x	x	x
Saltwater Marsh	✓	✓	✓	✓	✓	✓	✓	✓
Saltwater Swamp	x	✓	x	✓	x	x	✓	✓
Freshwater Aquatic	✓	✓	✓	✓	✓	✓	✓	✓
Freshwater Flat	✓	✓	✓	✓	✓	✓	✓	✓
Freshwater Marsh	✓	✓	✓	✓	✓	✓	✓	✓
Freshwater Swamp	✓	✓	✓	✓	✓	✓	✓	✓

✓ - present

x - absent

Figure 3. Distribution of wetland types by region

regional basis in the description and definition of wetlands, such as bog and pocosin, are discussed in the text at appropriate points.

Identification

13. The approach to the identification of wetlands in this guidebook series is to provide general classifications for each region of the country. For purposes of this series, the country has been divided into six large regions plus Alaska and Puerto Rico (as described earlier). Within each regional guide, a key (Table 1) is provided for classification of any site in question. The reader is then referred to a brief description of the type (Wetland Types, next section) for a preliminary check to see if the site was properly classified. Finally, the reader is referred to the text for a more complete description of the communities and associations in the wetland and a pictorial profile

Table 1

Key to Wetland Types

A. Aquatic vegetation predominant (dominant plants free-floating or attached and having poorly developed tissues of structural support, supported and buoyed up by the water); flooded usually for long periods or permanently	
B. Coastal; below the intertidal zone; seaward to limits of vascular plant growth; permanently flooded	SALTWATER AQUATIC
B. Inland; flooded permanently or semipermanently by fresh water	FRESHWATER AQUATIC
A. Terrestrial vegetation predominant (dominant plants rooted and with well-developed tissues of structural support) or sometimes barren of vegetation; flooded at least occasionally, often for prolonged periods	
C. 25 percent or less vegetative cover	
D. Subject to saltwater influence	
E. Coastal, tidal	SALTWATER COASTAL FLAT
E. Inland, nontidal	SALINE INLAND FLAT*
D. Fresh water	FRESHWATER FLAT
C. More than 25 percent vegetative cover	
F. Nonsaline soils	
G. 40 percent or less cover by woody plants	FRESHWATER MARSH
G. More than 40 percent cover by woody plants	FRESHWATER SWAMP
F. Saline (including brackish) soils	
H. 40 percent or less cover by woody plants	SALTWATER MARSH
H. More than 40 percent cover by woody plants	SALTWATER SWAMP

* The saline inland flat does not occur in those parts of the West Coast States defined by this guide.

Table 1 (Continued)

How to use the key: A key is an artificial device constructed for the purpose of identifying an unknown object. Keys traditionally have been used in the field of biology for the identification of unidentified plant and animal species, but in this guidebook the key will be used for the identification of unidentified wetland types.

The key to wetland types consists of a series of contrasting statements or descriptions, and the user of the key is required to make decisions based on the comparison of statements in the key as related to observations on the unidentified wetland type. The user must work carefully through the key from its beginning until a wetland type has been selected for the area in question.

The key is constructed around a series of pairs of leads. The second lead of a pair usually repeats the data given in the first lead but in a negative sense. Let us assume that you, the user of the guidebook, have located a grass-dominated area that obviously is "wet" during the better part of the year and obviously under the jurisdiction of the Section 404 program. Proper use of the key should enable you to determine just what type of wetland is involved.

In order to begin use of the key, you must start with the first pair of lead sentences, in this case labelled "A." Read each lead carefully, weighing one against the other with relation to your grass-dominated area. Grasses normally do not grow as free-floating organisms nor do they depend on water to buoy them upright, since they normally have sufficient supporting tissues to grow erect; in this case, then, the second lead of the pair of choices is better descriptive of the grass-dominated area with which you are concerned. You are now ready to consider a second pair of leads. This time you will consider the leads labelled "C" (of course, if your habitat were dominated by aquatic vegetation rather than terrestrial grasses, you would be considering the choices labelled "B"). Read the two "C" leads carefully, look at your grassy area, and try to determine how much of the ground surface is covered by vegetation. If less than 25 percent of the ground surface is covered by vegetation and more than 75 percent of the area is bare ground, you will select the first "C" as indicated; if vegetative cover accounts for more than 25 percent cover, you will take the second choice labelled "C." Let us assume that your area has only 10 percent cover. You will select the first "C" and then proceed to the "D" possibilities. Is the area in question flooded by fresh water or salt water? Let us make the assumption that you are in a freshwater area; look at the key carefully and note that the second "D" lead has a series of dotted lines leading to the phrase "Freshwater Flat." After the process of first rejecting and then accepting leads, you finally have arrived at an identification of your wetland type.

Table 1 (Concluded)

After determining the wetland type of an area in question, the user should turn to the detailed description of that particular type in the guidebook. In our hypothetical case the user would turn to page 45, FRESHWATER FLAT, and carefully read the descriptive material.

The use of the key may not be as simple and easy as it may seem. After you have followed the key through until coming to an identification of the wetland type, it may appear that the wetland description does not seem to fit the site. In that case it always pays to go back to the key and make sure an error has not been made through haste or misunderstanding of terms used. Occasionally an area may be found that cannot be identified with the aid of the key; the entire guidebook is written from a regional perspective and does not cover all variations of each wetland type. If a site does not fit any of the wetland types as described but yet is suspected of being a wetland under Section 404, a professional ecologist or botanist may be required for a quantitative study of the vegetation at the site.

illustrating its dominant species. The description of each wetland association is concluded with a section entitled "Field Identification," which briefly explains how to distinguish the wetland from other wetland types and from adjacent uplands. The entire description of a wetland should be studied prior to using the field identification section, however, to familiarize the user with its major variations. Wherever feasible, characteristics of growth forms are highlighted for identification, but if classification of an area is questionable, final determination must be based upon species composition.

14. If a site "fits" the description reasonably well, then the decision is clear that the area should be classified as a wetland of that particular type. The converse is not true, however. (If the site does not closely match one of the descriptions, it cannot be concluded unequivocally that the area is not a wetland.) This text is written from a regional perspective and consequently cannot be comprehensive and describe all variations within each wetland type. If a site does not fit any of the descriptions yet is still suspected to be a wetland, a quantitative survey of the vegetation of the area will be necessary. Especially in cases where the natural vegetation cannot be ascertained, hydrologic and soil information will be required to determine whether or not a site is a wetland. The nine basic wetland types are defined as follows:

a. Saltwater aquatic. Wetlands that are dominated by free-floating, rooted, or otherwise attached herbaceous plants (including macroscopic marine algae) and that are permanently flooded by saline or brackish water (e.g., sea grass beds).

b. Saltwater coastal flat. Wetlands that have 25 percent or less vegetative cover and are occasionally (shallow flat) or regularly (deep flat) flooded by saline water of tidal origin (e.g., nonvegetated intertidal zone).

c. Saline inland flat. Wetlands that have 25 percent or less vegetative cover and are occasionally or regularly flooded by saline water of nontidal origin (e.g., inland salt flat).

d. Saltwater marsh. Wetlands that have more than 25 percent vegetative cover of herbaceous plants but 40 percent* or less cover by woody plants and that are occasionally (high marsh) or regularly (low marsh) flooded by brackish or saline water (e.g., Smooth cordgrass marshes).

e. Saltwater swamp. Wetlands that have more than 40 percent cover of woody plants and are occasionally or regularly flooded by brackish or saline water (e.g., mangrove swamps).

f. Freshwater aquatic. Wetlands that are usually dominated by free-floating or rooted aquatic herbs and are semipermanently or permanently flooded by fresh water (e.g., floating duckweed mats).

g. Freshwater flat. Wetlands that have 25 percent or less vegetative cover and are occasionally or regularly flooded by fresh water (e.g., mudflats).

h. Freshwater marsh. Wetlands that have more than 25 percent vegetative cover of herbaceous plants but 40 percent or less cover by woody plants that are occasionally or regularly flooded by fresh water (e.g., cattail marsh).

i. Freshwater swamp. Wetlands that have more than 40 percent cover by woody plants and are occasionally or regularly flooded by fresh water (e.g., cypress swamps).

Organization of Guidebooks

15. Each guidebook is designed to be self-contained. Although this necessitates repetition of general information in the introductory part, the advantages in utility outweigh the duplication. The second part of each guidebook, entitled "Wetlands by Region," is the only one of the three parts unique with each guide. The third part, containing appendixes and references to pertinent publications, is largely specific for each region, except for a glossary that is common to the entire group of regional guides.

16. Three major sections are found in Part II: Regional Environment, Regional Botanical References, and Wetland Types. The section on

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* The use of 40 percent as the division for woody plant cover is convenient for field work because when the tree cover is 40 percent, the distance between tree crowns equals the mean radius of a tree crown (UNESCO, 1973).

regional environment is brief and provides a broad context for the more detailed descriptions of wetland types in each region. Because of the synonymy of many scientific names, the standard used for the guide is given in the section on regional botanical references.

17. Description of each wetland type is based upon data in the literature and from discussions with scientists having familiarity with the area. The goal is to provide a sufficiently detailed description for use in the field but not to report every possible variation of each wetland type. Thus, the descriptions are a comparison between site-specific reports and extremely general discussions.

18. The description of vegetation in each wetland type is divided into the following four parts:

a. Growth form. Growth form, such as deciduous (e.g., Alder, Bald cypress) or evergreen (e.g., pine, Sitka spruce) trees, is a concise description based upon the physiognomy of the vegetation. This should be particularly helpful to those not familiar with the species in the area.

b. Species composition. Discussion of species composition in each case includes listings in alphabetical order (by scientific name) of the dominant plants and the most commonly associated species. Because of local variation within any wetland type, an alphabetical listing is preferred over an attempt at listing species by importance value. The choice of associated species listed sometimes is arbitrary but, in the absence of complete species lists for each type, is inescapable. Profiles are provided for most wetland types. These diagrammatic depictions of vegetation structure are meant only to reinforce the textual material. The section on transition zones outlines the plants or plant communities characteristically found between adjacent wetland types or between wetlands and uplands. Such transitions may be abrupt but more often they are gradual. The generalized structure of each wetland type and its relationship to transition zones is indicated by a pictorial vegetation profile.

c. Physical environments. The environmental conditions, the characteristic water regimes, and soils of each wetland type, are described where available. The discussions are limited to aspects of the physical environment most often affecting the vegetation and are not intended to fully describe the environment.

d. Field identification. The section on field identification gives the characteristics that distinguish the wetland type from other wetland types and from adjacent uplands.

19. In most cases some attempt to discuss successional relationships of wetland communities is made. In many cases, however, the successional relationships of wetlands vegetation are too poorly understood for meaningful generalizations.

20. The primary purpose of the guidebook series is to aid regulatory functions personnel in identifying wetland types. For that reason a well-organized but general approach has been attempted. The classification system in the guides is intended solely for implementation in the Section 404 permit program and is not considered a definitive classification system for other purposes.

Botanical Nomenclature

Common names

21. Common names, while admittedly convenient, often vary from place to place. One species may have several names in different geographic regions, or the same name may be applied to unrelated species in different areas. Yet other species lack a common name. In the guidebook series, the common name used for a plant is the one, in the opinion of the author, most often used locally within the region. A single common name is used even though several names may be in use within the region. Those species not known to have a common name are referred to by their scientific name.

22. To assist in utility of the guides, an attempt has been made to provide a common name at each point where a scientific name appears. In a few cases, however, this has not been practical or has been considered superfluous; for that reason, in cases where assurance of communication seemed evident, a single name was employed.

Scientific names

23. Botanists, ecologists, and other scientists use scientific names in their technical publications and discussions. The Latin form of scientific names is definitive and uniformly adhered to by botanists around the world under the International Code of Botanical Nomenclature.

Thus, the Latin name of a plant species is understood by the scientific community throughout the world, regardless of the prevailing language in a country.

24. Scientific names used in this guidebook series consist of two words. The first word of the scientific name is that of the genus to which a plant belongs, and it is always capitalized. The second word of the scientific name is referred to as the specific epithet, and it is printed here in lower case even though it may be derived from a geographical name or the name of a person. Both words are italicized or underlined. Following the scientific name it is customary, at least in checklists, to give the name of the author or person who originally described the plant to science; the name of the author is referred to as the authority. The authority for plants in these guides is given in Appendix A and in most cases the authority is abbreviated.

25. The following example illustrates the function and meaning of a typical scientific name. The genus *Typha* was first described by the Swedish botanist Linnaeus, as was *Typha latifolia*, the Common cattail, which occurs over most of the United States. Its name, therefore, is written *Typha latifolia* L., indicating that this species was described by Linnaeus. The scientific name *latifolia* indicates that the plant has broad leaves, in this case an accurate description.

26. Occasionally, there is need to refer to an unidentified species of a particular genus; an unidentified species of *Potamogeton*, for example, would be referred to in the text as *Potamogeton* sp. Similarly, it is sometimes convenient to refer to a group of species of a particular genus without giving the complete scientific name of each. A group of species of the genus *Potamogeton* would be given as *Potamogeton* spp.

27. Within the text of a paragraph or more of material, it is considered redundant to repeat the complete scientific name repetitively after its initial use. The species *Potamogeton amplifolius* would be given in full where first mentioned but at later times might be referred to in the text as *P. amplifolius*, the *P.* being an abbreviated form of *Potamogeton*. In situations where confusion with other species might result, however, the scientific name is given in full.

Synonymy of scientific names

28. Many plant species have been given more than one scientific name in the course of botanical history. A species may have been described and named independently by different botanists, or two species may have been considered one and the same following a period of study. In addition, there are differences of opinion among professional botanists as to whether a variation merits recognition as a variety or as a separate species or perhaps needs no additional name.

29. Because of differences of interpretation, one will often find a particular plant referred to by different scientific names in two or more separate publications. For this reason each of the guidebooks in this series has been compiled with the use of a particular publication as a standard for botanical nomenclature. In each case the standard for botanical nomenclature is a well-known regional manual of plant identification. The standard for each guidebook is identified in the section entitled Regional Botanical References.

PART II: WETLANDS OF THE WEST COAST STATES

Regional Environment

30. The West Coast region extends from the Mexican to the Canadian border and includes California (except the southeastern section), western Oregon, and western Washington. This narrow strip is approximately one thousand miles long and one to two hundred miles wide. Mountain ranges form a giant H with the Oregon Coast Range and the Cascades as the upper part of the H, and the California Coast Ranges and the Sierra Nevadas as the lower part of the H. The Klamath mountains in northern California and southern Oregon form the cross bar of the H between the north-south ranging mountains. Between the Oregon Coast Range and the Cascades is the Puget Trough/Willamette Valley region, while the Central Valley of California separates the California Coast Ranges from the Sierra Nevadas. Elevations vary from slightly below sea level to over 4250 m on the highest mountain peaks, resulting in a diversity of wetland types.

31. The climate is extremely variable across the expansive latitudinal and topographic range of the region. Barbour and Major (1977) indicate that very little is known about California climatic factors, because the available climatic data is poor. Annual precipitation is less than 12.5 cm in the Central Valley of California and over 254 cm on the Olympic Peninsula in the Coast Range of Washington and also at higher elevations of the Cascades. Precipitation is highly seasonal in many parts of the region, particularly in coastal southern California, which is marked by a Mediterranean climate. Winter is the wet season throughout the region.

32. Temperature fluctuations on a seasonal basis are not pronounced. Mean July and January temperatures usually vary less than 17°C in any part of the region. July temperatures average above 27°C in the south and about 16°C in the Cascades. January temperatures average above 10°C in the south to about 4°C on the Olympic Peninsula.

33. The so-called Mediterranean climate of southern California is marked by hot, dry summers and cool but not cold, moist winters (Munz, in collaboration with Keck, 1973; Barbour and Major, 1977) and presumably has had a major influence on the evolution of the vegetation. The vegetation of coastal areas in southern California is dominated by pine forests and chaparral. Chaparral is a mixture of small trees and stout woody shrubs and typically grows on hills and lower mountain slopes. The broad-leaved evergreen species associated with the chaparral often form dense, nearly impenetrable thickets. The chaparral has a number of adaptive features that allow it to persist despite burning. Some of the shrub species have horizontal rootstocks that sprout again after the tops are removed by fire; other plants are kinds that reseed freely after fire and thus maintain themselves in the burned area. Many of the pines of the region also are favored ecologically by fire. The chaparral ascends to about 1500 m along the coast of southern California; in northern California, however, the chaparral is replaced by coastal redwood forests where rainfall and fog provide greater amounts of precipitation. The Central Valley of California is naturally a desert but has been developed agriculturally through the use of irrigation.

34. The northern portions of the West Coast region are dominated by temperate coniferous forest; Western red cedar, hemlock, Douglas fir, and spruce are dominant species. The vegetation of the Puget Trough/ Willamette Valley is extremely varied; Western hemlock forest, pine forest, oak woodland, and prairie all are encountered. The lowlands and valley bottoms generally are relatively warm, dry regions from which many of the mesic species common on nearby montane slopes are absent.

35. Wetlands in the West Coast region are both widespread and diverse, but they are much less extensive today than in the past. Large acreages of both saltwater and freshwater wetlands have been destroyed through salt-production activities and draining and clearing operations associated with agriculture and expanding urbanization.

Regional Botanical References

36. There is no single manual of plant identification applicable to the entire West Coast region. For that reason selection of a single work to serve as a standard for botanical nomenclature has not been possible.

37. Mason (1957) was used as a primary reference for the southern part of the region; that reference is well illustrated and specifically covers wetland plant species. In the northern part of the region, the work of Hitchcock et al. (1955-69) was used extensively.

38. Other taxonomic references of particular value to workers in the region include Munz (1973), Steward et al. (1963), and Hulten (1968). The ecological treatise on the vegetation of Washington and Oregon by Franklin and Dyrness (1973) also is useful, although few wetland types are treated specifically. The compendium of information on California vegetation edited by Barbour and Major (1977) similarly is of much value.

39. Resolution of the numerous discrepancies in botanical nomenclature among the several publications used as references in the construction of this guide was by necessity often arbitrary. Choice of common names is based on general usage in the guidebook region, but here also many decisions were made arbitrarily.

Wetland Types*

40. Of the nine possible wetland types, the West Coast region possesses eight. A brief definition of each type follows:

a. Saltwater aquatic. Wetlands that are dominated by free-floating, rooted, or otherwise attached herbaceous plants (including macroscopic marine algae) and are permanently flooded by saline or brackish water (e.g., seagrass beds).

b. Saltwater coastal flat. Wetlands that have 25 percent or less vegetative cover and are occasionally or regularly

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* See Appendix C for an interpretation of the definition of wetlands.

flooded by saline water of tidal origin (e.g., sparsely vegetated intertidal zone).

c. Saltwater marsh. Wetlands that have more than 25 percent vegetative cover of herbaceous plants but 40 percent or less cover by woody plants and are occasionally or regularly flooded by brackish or saline water (e.g., hairgrass marsh).

d. Saltwater swamp. Wetlands that have more than 40 percent cover of woody plants and are occasionally or regularly flooded by brackish or saline water (Goodding's and white willow swamps).

e. Freshwater aquatic. Wetlands that are dominated usually by free-floating or rooted aquatic herbs and are semi-permanently or permanently flooded by fresh water (e.g., water lily stands).

f. Freshwater flat. Wetlands that have 25 percent or less vegetative cover and are occasionally or regularly flooded by fresh water (e.g., mudflats in reservoir draw-down areas).

g. Freshwater marsh. Wetlands that have more than 25 percent vegetative cover of herbaceous plants but 40 percent or less cover by woody plants and which are occasionally or regularly flooded by fresh water (e.g., cattail marsh).

h. Freshwater swamp. Wetlands that have more than 40 percent cover by woody plants and are occasionally or regularly flooded by fresh water (e.g, Black cottonwood-willow-alder swamps).

SALTWATER AQUATIC WETLANDS

Definition: Wetlands that are dominated by free-floating, rooted, or otherwise attached aquatic herbs or algae and are flooded permanently (or near permanently) by brackish or saline water.

41. The saltwater aquatic wetland is distributed along the entire Pacific Coast. The shoreward limit is generally the elevation of the lower mean tide, while the seaward boundary is the limit of attached macrophytic plant growth. Plants are exposed to air only during exceptionally low tides in most cases.

42. Although there is no accurate appraisal of the total area occupied by this wetland type, 2000 hectares of Eelgrass have been identified in Oregon; areas of Eelgrass adjacent to the Washington coast have been mapped, but the total area has not been calculated.

43. Seagrass beds, particularly of Eelgrass, in the saltwater subtidal zone are an extremely important contributing factor to the productivity of estuaries and coastal areas. Submerged saltwater aquatic wetlands play several other significant roles. The vascular plants of the seagrass beds serve as substrates for an epiphytic assemblage of algae and simple invertebrates. The beds also are important habitats for various fish and shellfish as well as for diving ducks and certain other waterfowl.

44. Beds of macroscopic marine algae (representing Brown algae, Red algae, and Green algae) occur in relatively shallow marine waters of the region; the algal beds attain high development in offshore coastal areas. Kelps (large Brown algae) are the most complex of all algae and have large, differentiated plant bodies that are superficially similar to those of higher plants.

45. Dense subtidal stands of kelps and other large seaweeds afford protection, breeding, spawning, and grazing areas for a variety of marine animal species. The large algal plant bodies serve as substrates to which a variety of marine life is attached. Some marine organisms feed directly on the algae, while others depend upon the detrital

material provided by these large algae. Many of the large seaweeds make important contributions to phytoplankton populations (and hence primary production) through liberation of reproductive cells (*Nereocystis* releases an estimated 3,000,000 reproductive cells per litre of water per day from June through September).

VEGETATION

46. Growth forms and physiognomy: submerged, narrow-leaved herbaceous plants, such as Eelgrass, and algae with leaflike blades (macroscopic forms), in sparse to dense stands.

47. Species composition of the saltwater aquatic wetland (potentially dominant species):

Phyllospadix scouleri (Surfgrass, Open-coast eelgrass)
Ruppia maritima (Widgeon grass)
Zostera spp. (Eelgrass)

Agardhiella spp. (Red algae)
Alaria spp. (Brown algae), Winged kelp
Codium spp. (Green algae), Dead man's fingers
Hymenena spp. (Red algae)
Iridaea cordata (Red algae)
Laminaria spp. (Brown algae), Devil's apron
Lessonia spp. (Brown algae)
Macrocystis spp. (Brown algae), Giant or Vine kelp
Nereocystis spp. (Brown algae), Bull or Bladder kelp
Postelsia spp. (Brown algae), Sea palm
Pterygophora spp. (Brown algae)
Ulva spp. (Green algae), Sea lettuce

Dominant and associated species. Eelgrass often is the only species of higher plant present in seagrass beds. Despite the paucity of vascular plant species, these areas support an extremely diverse fauna as well as many microscopic algae (such as diatoms) that reside epiphytically on the Eelgrass. Eelgrass beds that have rocks scattered on the surface commonly have the algae *Ulva lactuca* or *Agardhiella tenera* as associates.

Algal beds (primarily of large marine Brown algae), unlike Eelgrass beds, support many important species and have the plants arranged in distinct vertical strata; species diversity in the algal beds is high and selection of dominant species in the preceding list was largely arbitrary. Large, massive kelp species (*Macrocystis*, *Nereocystis*, *Iridaea*, etc.) form a canopy that effectively reduces light penetration beneath them. Vertical layering below the canopy is evidenced by long-stalked species (*Lessonia* spp.) situated above a lowermost layer of relatively smaller algae such as *Codium* or *Hymenena*.

Long-term observations on the successional relationships of seagrass communities are few. According to den Hartog (1977), the *Phyllospadix* beds of the Pacific coast are successional to the development of the permanent submarine forests dominated by *Macrocystis* and other giant kelps. *Phyllospadix* apparently remains permanently only on those sites that are too shallow for the development of large kelps. *Zostera* beds appear to represent both pioneer and permanent stages of succession.

Transitional species. The saltwater aquatic community frequently borders other wetland types. The seaward limit of the algal community corresponds with the limit of algal attachment, while the seaward limit of the seagrass beds is the limit of rooted plant growth. The shoreward boundary is usually the lower limit of the intertidal zone. Eelgrass commonly occurs in the tidal channels of salt marshes as well as in intertidal stands; occasionally it occurs in the lower edges of the saltwater flat. Kelps extend from the lower intertidal region (where they often are dominant) to depths of 20 metres or more.

ENVIRONMENTAL CONDITIONS

48. Eelgrass commonly is found in estuarine areas of silty substrates that have a strong saltwater influence. The depth of the water in which it grows may be as much of 7 metres, or the water may be very shallow.

49. Kelps and other forms of macroscopic algae grow in coastal waters having salinities as high as those in the ocean proper as well as in estuarine environments having relatively low salinities. The very large kelps, such as *Nereocystis*, *Macrocystis*, etc., are found in waters from 8 to 35 metres deep. Many of the smaller forms, however, typically are found in the lower intertidal and upper subtidal areas.

50. The ocean often appears to provide a relatively uniform environment, but the underlying topography and substrate actually may be highly variable; diversity in physical and chemical factors of the marine environment is reflected in the species diversity supported by the environment. Rocky coastlines support both the greatest diversity and the largest number of organisms. Unstable substrates such as muds and sands generally support few macroscopic algal species, although microscopic and mat forming filamentous forms may be abundant. The strength of the currents likewise plays an important role in determining species distribution.

51. The macroscopic Brown algae are abundant along much of the Pacific Coast and many species are characteristic of the intertidal and shallower subtidal areas. In such areas a striking vertical zonation of species often occurs. This zonation is due to a phenomenon associated with tidal patterns in the water. The physical-chemical conditions in the shallow water along the coastline are highly variable, often changing greatly along very small vertical distances. Gradients relating to salinities, nutrient availability, light, and temperature are interrelated with the tidal phenomenon in complex patterns, contributing to distinct vertical zonation of species. Waaland (1977) discusses seaweed habitats in some detail.

SALTWATER COASTAL FLAT

Definition: Wetlands that have 25 percent or less vegetative cover and are occasionally or regularly flooded by saline water of tidal origin

52. Coastal flats form a fringe along the seaward edge of salt marshes and along sandy and silty estuarine shorelines. Relatively few plants grow in these wetlands, but saltwater flats play an extremely important role in estuarine benthic production and mineral cycling. Several species of birds (including Belding's savannah sparrow, California clapper rail, and Light-footed clapper rail) frequent this wetland type.

VEGETATION

53. Growth forms and physiognomy: nonvegetated or sparsely vegetated with succulent forbs, plants often in circular stands.

54. Species composition of the saltwater coastal flat wetland:

Dominant species

Cotula coronopifolia (Brass buttons)
Distichlis spicata (Saltgrass)
Eleocharis parvula (Spike rush)
Puccinellia pumila (Alkali grass)
Ruppia maritima (Widgeon grass)
Salicornia spp. (Glasswort or Pickleweed)
Scirpus americanus (Three-square bulrush)
Scirpus maritimus (Saltmarsh bulrush)
Scirpus validus (Soft-stemmed bulrush)
Spergularia canadensis (Sand spurry)
Spergularia marina (Saltmarsh sand spurry)
Triglochin maritima (Sea arrowgrass)
Zannichellia palustris (Horned pondweed)
Zostera spp. (Eelgrass)

Cladophora spp. (Green algae)
Enteromorpha spp. (Green algae)
Fucus spp. (Brown algae), Rockweed
Ulva spp. (Green algae), Sea lettuce

Associated species

Carex lyngbyei (Lyngbye's sedge)
Spartina foliosa (Cordgrass, California cordgrass)
Almost any species normally found in the salt marsh also occurs here

Dominant and associated species. Coastal flats intergrade closely with low salt marshes. The species composition of the coastal flat usually is similar to that of areas that lie above it, usually the lower edges of low salt marsh. Stands composed of any one of the following species often represent the low-lying edges of more densely covered marsh communities: Sea arrowgrass, Salt-marsh bulrush, Three-square bulrush, Soft-stemmed bulrush, and Spike rush. Sea arrowgrass and the bulrushes tend to grow in circular stands, while the Spike rush has a linear growth pattern, which is due largely to its rhizomatous nature. Sea arrowgrass tends to associate with silty substrates, while Pickleweeds and Spike rush are found on sandy substrates.

Coastal flats often support assemblages of macroscopic algae of much smaller size than those found in the saltwater aquatic wetland. Algal genera found on the flats include *Cladophora*, *Enteromorpha*, *Fucus*, and *Ulva*. Eelgrass (*Zostera* spp.) often is scattered among the algal colonies.

Saltwater coastal flats often are successional in nature, ultimately developing into saltwater marshes. In Washington, for example, tideflats often are colonized by the pioneers *Distichlis spicata*, *Salicornia virginica*, and *Triglochin maritima*. In Oregon the most typical pioneer invader of flats probably is *Triglochin maritima*, but other important primary colonists are *Salicornia virginica*,* *Scirpus* spp., and *Carex lyngbyei*. *Spartina foliosa* is a pioneer in parts of California.

Transitional species. Coastal flats usually grade into salt marsh communities. There are few differences in the species composition between saltwater coastal flats and the lower edges of saltwater marshes; the two wetland types must be distinguished quantitatively on the basis of plant cover, flats having less cover than marshes.

At their lower edges coastal flats usually support no vascular plants. These intertidal areas commonly develop a sparse cover of filamentous algae during the summer months. The lower edge of this largely barren zone is adjacent to the saltwater aquatic wetland in many areas.

ENVIRONMENTAL CONDITIONS

55. Coastal flats commonly are exposed only a few hours at a time during the tidal cycle. Salinities in coastal flat substrates generally range from 10 to 34 ppt. Salinities in estuarine flats may be reduced to less than 10 ppt due to freshwater influence.

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* See note on page 36.

FIELD IDENTIFICATION

56. Coastal flats characteristically are areas of exposed sediments adjacent to the ocean. Plants on the flats often grow in circular patches and are widely scattered in distribution. During the winter months, coastal flats commonly have the exhumed tubers and eroded stubble of bulrush stems.

SALTWATER MARSH

Definition: Wetlands that have more than 25 percent cover of herbaceous plants but 40 percent or less cover by woody plants and that are occasionally or regularly flooded by brackish or saline water

57. Saltwater marshes are scattered along coastal shorelines protected from excessive wave action, as around edges of bays, lagoons, and estuaries or behind islands and barrier spits. The most extensive salt marshes in the West Coastal States region occur in California; the largest tracts occur around San Francisco, Los Angeles, and San Diego. Barbour and Major (eds., 1977) estimated that approximately 36,000 hectares remain in California, this figure representing less than half of the original area once covered by salt marshes. MacDonald and Barbour (1974) estimated that Washington has about 4500 hectares of salt marsh, while Oregon has about 3040 hectares.

58. A major loss of salt marshes has occurred through diking in estuarine areas, which effectively eliminates surface water inundation. Interestingly, Johannessen (1964) has shown a dramatic expansion in the salt marshes of Oregon over the last 100 years; he attributed the expansion to increased rates of soil erosion and tideflat deposition, which followed the movement of European colonists into Oregon.

59. Salt marshes are considered highly productive systems, providing large amounts of organic detrital materials that may be washed into the adjacent saltwater coastal flats and saltwater aquatic communities. This detritus is an extremely important source of food for many aquatic animal species. Salt marshes also provide habitat for fish, shellfish, and waterfowl.

VEGETATION

60. Growth forms and physiognomy: graminoids (grasses, sedges, and rushes) and succulent forbs, varying in height from low vegetation to stands of Bull tule that are almost 2 m tall; in sparse to dense stands.

61. Species composition of the saltwater marsh:

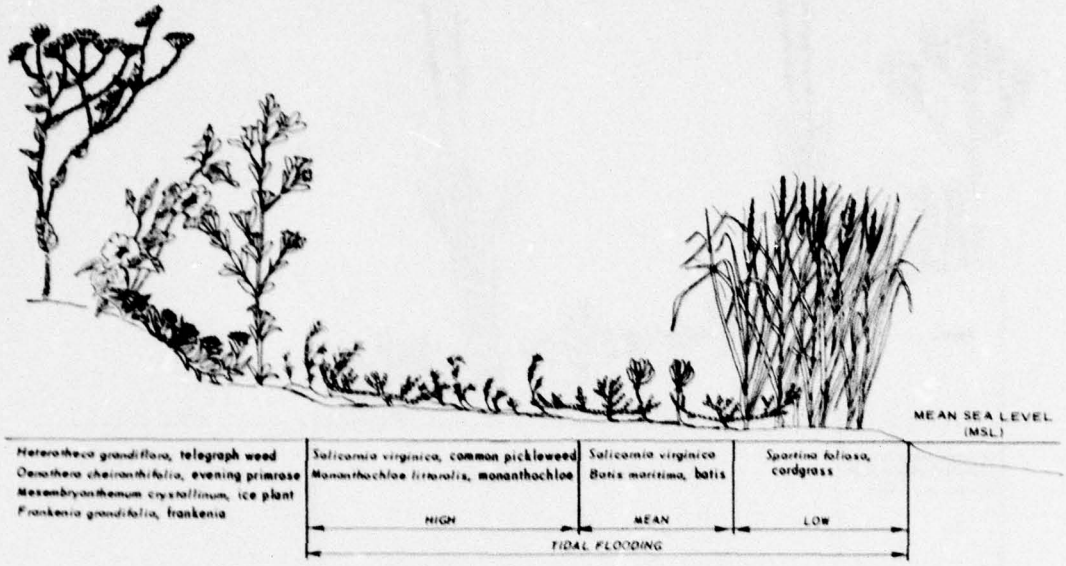

Figure 4. Generalized salt marsh profile (southern)

The reader is cautioned that the generalized floristic profiles contained within this guide are oversimplified and are not representative of many sites that will be found in the field. Wetland systems are dynamic, and many variations will be found. Species listed as "typical" on the profiles are those that generally occur as dominants in the particular wetland types. Those listed as "transitional" are those that regularly are associated with the transition zones at the margins of the individual wetland types. Associated species are those that are of common occurrence in a particular wetland type but generally are not sufficiently abundant to be dominants.

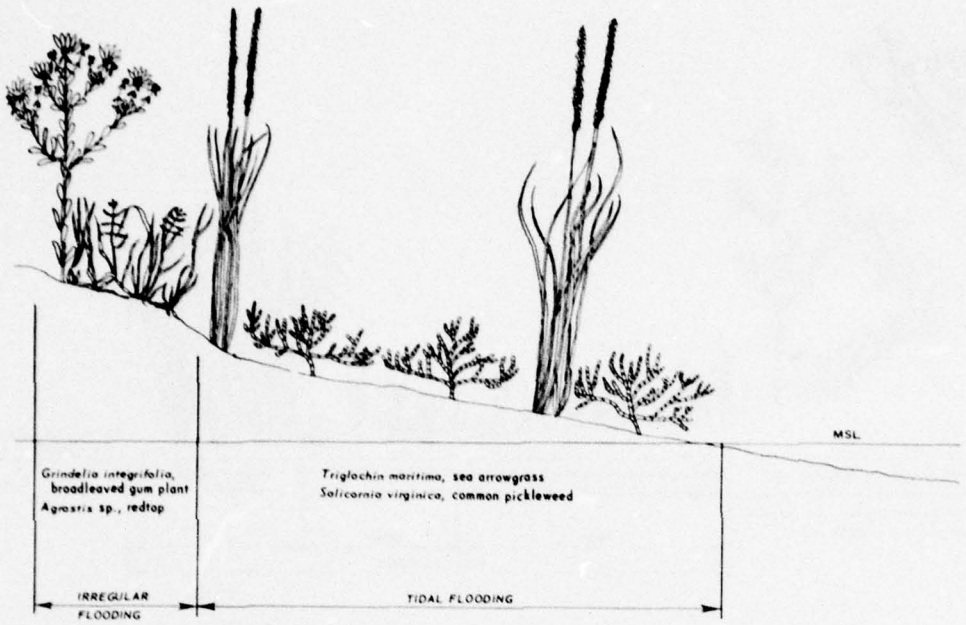

Figure 5. Generalized profile of northern low salt marsh

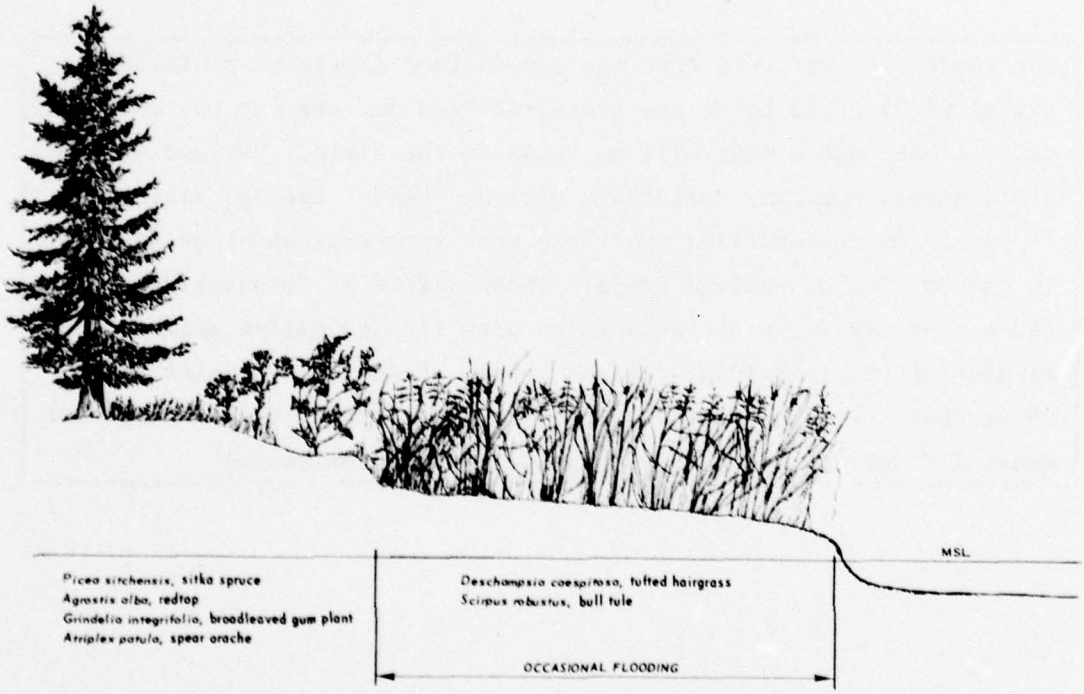

Figure 6. Generalized profile of northern high salt marsh

Dominant species

Carex lyngbyei (Lyngbye's sedge)
Deschampsia caespitosa (Tufted hairgrass)
Distichlis spicata (Saltgrass)
Frankenia grandifolia (Frankenia)
Jaumea carnosa (Jaumea)
Juncus balticus (Baltic rush)
Salicornia spp. (Glasswort)
Scirpus robustus (Bull tule)
Scirpus validus (Softstem bulrush)
Spartina spp. (Cordgrass)
Triglochin maritima (Sea arrowgrass)

Associated species

Achilla millefolium (Yarrow)
Agrostis alba (Creeping bentgrass)
Atriplex patula (Fat-hen)
Batis maritima (Saltwort)
Cordylanthus maritimum (Bird's beak)
Cuscuta salina (Dodder)
Eleocharis macrostachya (Creeping spikerush)
Glaux maritima (Sea milkwort)
Grindelia spp. (Gum plant)
Hordeum jubatum (Foxtail barley)
Juncus effusus (Common rush)
Limonium californicum (Sea lavender)
Monanthochloe littoralis (Shore grass)
Myosurus minimus (Mousetail)
Oenanthe sarmentosa (Oenanthe)
Plantago maritima (Goosetongue)
Potentilla spp. (Silverweed)
Scirpus californicus (Three-square bulrush)
Spergularia canadensis (Sand spurry)
Trifolium wormskjoldii (Coast clover)

Dominant and associated species. The species composition of the salt marsh is highly variable; there is a trend toward increased species diversity from north to south within the West Coast region. Species of abundance throughout most of the region are *Salicornia* spp., *Distichlis spicata*, *Jaumea carnosa*, and *Triglochin maritima*. Local dominance by other species is affected by latitude and tidal elevation. Many of the coastal marshes show a distinct zonation of plant communities as one moves up the intertidal zone to higher elevations. In the more northerly marshes, a distinction can be made between low and high marsh, but in many respects the transition becomes more gradual to the south. MacDonald and Barbour (1974) and MacDonald (1977) distinguished an intermediate marsh type (dominated by *Salicornia bigelovii*, a low form of

S. virginica,* *Batis maritima*, and *Frankenia grandifolia*) in more southerly portions of the region. At the same time, when referring to California marshes, MacDonald (1977) indicated that the existence or nonexistence of vegetation zones is largely a matter of definition. The zones that often are evident generally reflect mere changes in growth habit and most often do not reflect variation of community structure.

Marshes on the Pacific coast having relatively high salinities support a limited number of dominant halophyte species. MacDonald and Barbour (1974) said the number often is less than 10 and rarely as much as 20. At lower salinities, however, the number of species increases dramatically, often with the inclusion of many weedy or upland species.

Southern low marshes are characterized by Cordgrass (*Spartina* spp.), Pickleweed (*Salicornia* spp.), Saltwort (*Batis maritima*), and Sea arrowgrass (*Triglochin maritima*). Cordgrass often occurs as the sole dominant in dense stands; however, it is absent in many places and elsewhere often shares dominance with *Salicornia* spp. Northern low marshes are characterized by spike rushes (*Eleocharis* spp.), Sand spurry (*Spergularia canadensis*), *Salicornia* spp., Three-square bulrush (*Scirpus californicus*), and Sea arrowgrass (*Triglochin maritima*). Sandy substrates often support dense mats of *Salicornia* spp. intermixed with *Jaumea*, Three-square bulrush (*Scirpus californicus*), and Sea arrowgrass (*Triglochin maritima*). Sandy substrates often support Sea arrowgrass with occasional Sand spurry. These communities of the low marsh usually have less cover than in the high marsh communities.

Southern high marshes are characterized by Tufted hairgrass (*Deschampsia caespitosa*), Saltgrass (*Distichlis spicata*), Creeping bentgrass (*Agrostis alba*), Lyngbye's sedge (*Carex lyngbyei*), *Frankenia*, Goosetongue (*Plantago maritima*), Shore grass (*Monanthochloe littoralis*), and Dodder (*Cuscuta salina*). In the extreme southern part of the region near San Diego, the following species are also frequent: *Atriplex patula*, *Cordylanthus maritimus*, and *Eleocharis macrostachya*. South of the Santa Barbara-Goleta area, *Salicornia subterminalis* and *Batis maritima* are important in this zone. Northern high marshes are characterized by Lyngbye's sedge (*Carex lyngbyei*), Tufted hairgrass (*Deschampsia caespitosa*), Creeping bentgrass (*Agrostis alba*),

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* Some authorities do not consider the West Coast plants conspecific with *S. virginica* of the Atlantic Coast, in which case the Pacific Coast populations are called *S. pacifica* Standley.

Potentilla spp., Saltgrass (*Distichlis spicata*), and Gum plants (*Grindelia* spp.). Yarrow (*Achillea millefolium*) is occasional. Areas of brackish nature are characterized by *Scirpus* spp. and Common cattail (*Typha latifolia*) along with Lyngbye's sedge (*Carex lyngbyei*).

Once formed coastal saltwater marshes appear to be long persisting and successionally stable.

Transitional species. Sitka spruce (*Picea sitchensis*) often dominates the zone above the high saltwater marshes in Oregon and Washington. Sitka spruce is tolerant of salt spray and occasional inundation by extreme high tides. *Agrostis alba*, *Grindelia* spp., *Potentilla* spp., *Plantago maritima*, and *Oenanthe sarmentosa* also extend into the transition zone. If the coastal marsh is backed by a freshwater marsh, Common tule (*Scirpus acutus*) and Common cattail (*Typha latifolia*) often occur in the transition zone.

Coastal saltwater marshes in California are backed by somewhat different plant communities than is the case further north. The transition zone behind marshes in the San Francisco area includes *Cordylanthus maritimus*, *Atriplex patula*, *Potentilla* spp., and *Frankenia*. These species are in the salt marsh itself, along with Sea rocket (*Cakile maritima*), Brass buttons (*Cotula coronopifolia*), and Mexican tea (*Chenopodium ambrosioides*). Sitka spruce extends south only into northern California.

The lower limit of the salt marsh normally is easily delineated; under most circumstances salt marsh on the West Coast establishes at about mean lower high water (MLHW), the average height of the lower of the two unequal high tides occurring daily under the mixed-tide regime. The upper boundary of the salt marsh often is hard to distinguish, but often it is at extreme high water (EHW). At many localities EHW corresponds to an abrupt change of slope and a line of stranded logs, algae, and other debris deposited by high tidal waters. Logs and various other forms of debris, therefore, often characterize the transition zones of many marshes along the coastline, particularly in Washington and Oregon. The logs and other materials often serve as islands on which plant species more typical of the uplands become established. When such islands are lodged out in the marsh itself, they should not be confused with the actual transition zone.

ENVIRONMENTAL CONDITIONS

62. Salinity of soils in coastal marshes decreases along an elevational gradient from that of sea water (34 ppt) to only slightly saline at points where freshwater flow dilutes the sea water. Salinity

levels often are significantly reduced during the rainy season. Low marshes generally are exposed for fewer than 100 diurnal periods per year, while high marshes are exposed more frequently. High marshes are exposed by 90 to 95 percent of the low tides, while low marshes are exposed to 75 to 80 percent of the low tides.

FIELD IDENTIFICATION

63. Coastal saltwater marshes are identified readily by their usual location adjacent to the ocean or brackish waters and by the dominance of herbaceous graminoid plants. The forbs that are present often are succulents. Saltwater marshes are found in the upper intertidal zone and usually have a dense cover of vegetation.

SALTWATER SWAMP

Definition: Wetlands that have more than 40 percent cover by woody plants and that are occasionally or regularly flooded by brackish or saline water

64. There are few saltwater swamps in the West Coast region. Most of these swamps are found on islands in the delta region of California. Saltwater swamps also form a fringing edge to saltwater marshes in Oregon and Washington. The swamps provide an important nesting habitat for birds that feed in the adjacent marshes.

VEGETATION

65. Growth forms and physiognomy: moderately dense to dense stands of deciduous trees, to 9 or 12 m tall; usually with a dense understory of shrubs and herbs.

66. Species composition of the saltwater swamp:

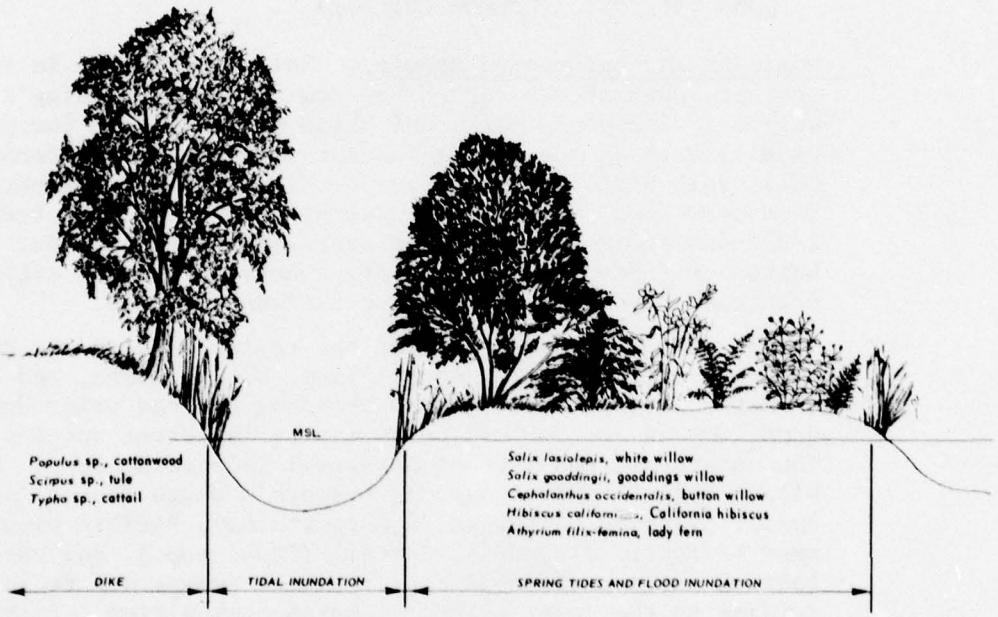

Figure 7. Generalized profile of California willow saltwater swamp

Dominant species

Alnus oregana (Red alder)
Cornus stolonifera (Red osier dogwood)
Salix spp. (Willow)

Associated species

Athyrium filix-femina (Lady fern)
Carex obnupta (Slough sedge)
Cephalanthus occidentalis (Buttonbush)
Equisetum spp. (Horsetail)
Hibiscus californicus (California hibiscus)
Hydrocotyle verticillata (Marsh pennywort)
Limosella subulata (Mudwort)
Lonicera involucrata (Twinberry)
Phragmites communis (Common reed)
Potentilla egedii (Pacific silverweed)
Samolus parviflorus (Water pimpernel)
Scirpus acutus (Tule)
Scirpus californicus (California bulrush)
Scirpus olneyi (Olney's bulrush)
Scirpus americanus (Three-square bulrush)
Tillaea aquatica (Water stonecrop)
Typha angustifolia (Narrow-leaf cattail)
Typha latifolia (Common cattail)

Dominant and associated species. Saltwater swamps in the southern part of the region are dominated by Goodding's willow (*Salix gooddingii*) and White willow (*Salix lasiolepis*), usually with an occasional Sandbar willow (*Salix interior*). California hibiscus (*Hibiscus californicus*) and Twinberry (*Lonicera involucrata*) form a shrub layer with Lady fern (*Athyrium filix-femina*) often scattered in the stands. Bulrushes (*Scirpus* spp.) and other herbs are found either scattered through the stands or in dense patches.

Swamps in the northern part of the region usually are dominated by willows (*Salix scouleriana*, *S. lasiandra*, and *S. hookeriana*); Red alder (*Alnus oregana*) and Red osier dogwood (*Cornus stolonifera*) also may be important species. The understory consists of Horsetail (*Equisetum* spp.), Slough sedge (*Carex obnupta*), Lyngbye's sedge (*Carex lyngbyei*), Creeping bentgrass (*Agrostis alba*), Pacific silverweed (*Potentilla egedii*), Cattail (*Typha* spp.), and various Bulrush species (*Scirpus* spp.). These swamps are found as fringes to the lower saltwater marsh communities. Sitka spruce (*Picea sitchensis*) is found occasionally in these areas and usually has a buttressed base when growing in the swamp.

Transitional species. The transition zones between swamp and adjacent upland communities in the southern part of the

region usually include scattered willows, bulrushes, cattails, and California hibiscus. In the more northern areas, the transitions usually contain Red alder, Sitka spruce, and hemlock.

ENVIRONMENTAL CONDITIONS

67. West Coast saltwater swamps differ from those in many other regions, such as peninsular Florida where the plants are often subject to regular tidal flooding. On the West Coast, the saltwater swamps are flooded by tides on an irregular basis; consequently, the salinity values often are reduced considerably below those of sea water (34 ppt).

FIELD IDENTIFICATION

68. Saltwater swamps can be recognized by the usual dominance of willows and by their location adjacent to the ocean or to saltwater marshes.

FRESHWATER AQUATIC WETLAND

Definition: Wetlands that are dominated by free-floating or rooted aquatic herbs and are semipermanently or permanently flooded by fresh water

69. Freshwater aquatic wetland communities are scattered throughout the region in ponds and along the shorelines of large lakes, rivers, and streams. Typically they are found in association with bodies of open water in which the vegetation cover is low. The plants found in the open water areas are the same as those found in the freshwater aquatic type; emphasis is placed here on the structure and composition of communities in which plant cover is relatively high. Freshwater aquatic wetlands provide food and shelter for most freshwater sport and commercial fish, for waterfowl, and for furbearers.

VEGETATION

70. Growth forms and physiognomy: free-floating herbs, such as Water fern, and rooted aquatic herbs, such as Yellow water lily; in open to dense, though sometimes scattered, stands.

71. Species composition of the freshwater aquatic wetland:

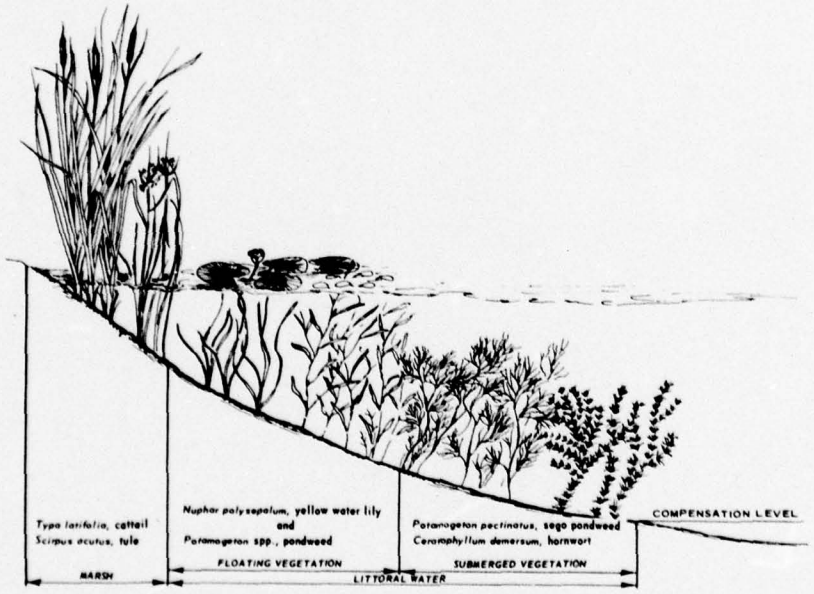

Figure 8. Generalized profile of a freshwater aquatic wetland

Dominant species

Azolla filiculoides (Water fern)
Nuphar polysepalum (Yellow water lily)
Potamogeton pectinatus (Sego pondweed)
Potamogeton robbinsii (Pondweed)

Associated species

Callitriche spp. (Water starwort)
Ceratophyllum demersum (Hornwort, Coontail)
Chara spp. (Stonewort)
Elodea canadensis (Waterweed)
Elodea nuttallii (Waterweed)
Lemna perpusilla (Duckweed)
Lemna trisulca (Duckweed)
Myriophyllum spicatum (Water milfoil)
Najas spp. (Water nymph)
Nitella spp. (Green algae), commonly called Stonewort
Nymphaea odorata (White water lily)
Potamogeton berchtoldii (Pondweed)
Potamogeton epihydrus (Pondweed)
Potamogeton richardsonii (Pondweed)

Dominant and associated species. The deepest portions of the freshwater aquatic wetland in many cases are dominated by Sego pondweed (*Potamogeton pectinatus*) and Hornwort (*Ceratophyllum demersum*); these species are completely submerged. In more shallow areas, Yellow water lily (*Nuphar polysepalum*) and various pondweeds are most important. The leaves of *Nuphar* float on the water surface, while those of the pondweeds are mostly submerged. Water fern (*Azolla filiculoides*) and the duckweeds, all of which are free-floating, are scattered among the other plants in quiet areas. The floating *Azolla* and *Lemna* plants often are moved from one part of a water body to another by wind or currents and frequently form small dense stands to the total exclusion of attached plant species.

Freshwater aquatic communities can be successionally stable where stream flow is minimal, but succession to freshwater marsh can be rapid if the lake or pond is filling with sediment. Usually the earliest invaders from the marsh are Tule (*Scirpus acutus*), Burreed (*Sparganium* spp.), Common cattail (*Typha latifolia*), Creeping spike rush (*Eleocharis macrostachya*), Reed canarygrass (*Phalaris arundinacea*), or Spiraea (*Spiraea douglasii*).

Transitional species. Normally the transition is to freshwater marsh in the direction of drier or more shallow areas; the species found in the transition zone usually are the same ones that tend to invade the freshwater aquatic areas (*Scirpus acutus*, *Sparganium* spp., *Typha latifolia*, etc.).

The freshwater aquatic community rarely adjoins uplands unless the intervening marsh has been destroyed. When in contact with deep open water, the transition from freshwater aquatic wetland to open water usually is a gradual diminution in plant cover with essentially no change in species composition.

ENVIRONMENTAL CONDITIONS

72. The freshwater aquatic community usually is flooded permanently or nearly permanently; if it becomes dry for any reason, it is invaded rapidly by freshwater marsh species. The outer limit of the freshwater aquatic wetland is the limit of rooted vascular plant growth, and the water depth at that point rarely exceeds three metres. The freshwater aquatic wetland appears to be influenced by degree of water hardness: the more solutes in the water, the denser the vegetation.

FIELD IDENTIFICATION

73. The freshwater aquatic community is dominated by herbaceous species, which distinguishes it from the freshwater swamp. The freshwater aquatic community is dominated by both rooted and free-floating aquatic plant species, which separates it from freshwater marshes, in which many nonaquatic species grow and in which the free-floating species (such as *Nymphaea* spp.) normally are not dominant.

FRESHWATER FLAT

Definition: Wetlands that have 25 percent or less vegetative cover and are occasionally or regularly flooded by fresh water

74. Freshwater flats are most prevalent around large reservoirs where water levels fluctuate greatly during the year. They also occur on stream and river margins, gravel bars, and sand bars. Some flats are important feeding areas for shorebirds that eat invertebrates burrowing in the mudflats. Few vascular plants grow on flats, but the flats can have surprisingly high primary production rates, due to the algae that grow in the mudflats and on rocky shores.

VEGETATION

75. Growth forms and physiognomy: barren or with scattered herbaceous plants and often with algae.

76. Species composition of the freshwater flat (potentially dominant species):

Echinochloa crus-galli (Barnyard grass)
Equisetum spp. (Horsetail)
Juncus effusus (Common rush)
Nasturtium officinale (Water cress)
Polygonum hydropiper (Marsh pepper)
Rumex crispus (Curly dock)
Salix spp. (Willow)
Xanthium spp. (Cockleburr)

Cladophora spp. (Green algae)
Lyngbya spp. (Blue-green algae)
Mougeotiopsis spp. (Green algae)
Protococcus spp. (Green algae)
Oscillatoria spp. (Blue-green algae)

Dominant and associated species. Many of the vascular plants found on freshwater flats occur as scattered individuals and, though of a competitive weedy nature, seldom persist through high water periods. Woody species, such as Willow (*Salix* spp.), occur as seedlings scattered in the lower edges of bars. Algae often occur in zones that probably are determined by flooding frequency.

Transitional species. Freshwater flats usually border open water at their lower edge. At their higher edge they may meet marshes, swamps, or nonwetland communities. The bound-

ary in any case can be determined by evaluation of the plant cover. If the site has 25 percent or less cover, it is an inland freshwater flat.

ENVIRONMENTAL CONDITONS

77. Inland freshwater flats commonly are inundated throughout high water periods and normally are exposed during periods of low water. The soils are saturated most of the year. Soil types vary from silt and clay to coarse sand and gravel. High water periods are significant to both erosion and accumulation of soils.

FIELD IDENTIFICATION

78. Freshwater flats may be identified by the extensive exposed substrates with a sparse vegetative cover. Frequently the exposed substrate surface is littered with remains of diatoms (a group of unicellular algae that have silica shells or frustules that are long persistent).

FRESHWATER MARSH

Definition: Wetlands that have more than 25 percent vegetative cover of herbaceous plants but 40 percent or less cover by woody plants and that are occasionally or regularly flooded by fresh water

79. Freshwater marshes occur throughout the West Coast region. In coastal areas they occur as deflation plain marshes in dune landscapes, as coastal fens, or as lake margin marshes. In the Central Valley, freshwater marsh wetlands are found adjacent to lakes and rivers in the form of shallow depressions in alluvial topography. In the mountainous areas, freshwater wetlands take the form of seasonally wet meadows and fens.

80. Many common names have been applied to various types of marshes based upon whether their soils are mineral or organic (peat), whether they receive nutrients only from precipitation (ombrotrophic) or from groundwater as well (minerotrophic), and other criteria relating to drainage patterns. For this guidebook series, all of these variations are considered freshwater marshes on the basis of herbaceous plant domination. The West Coast region exhibits the four distinct subtypes given below, which are based primarily upon soil type (e.g., mineral or organic), the nature of the water table (e.g., stable or fluctuating), whether the plants are annual or perennial, and altitude.

a. Coastal deflation plain marsh: low altitude marshes with sandy (mineral) soil and a shallow, stable water table; plants perennial

b. Riparian and lacustrine marsh: low to medium altitude marshes with mineral soil and a fluctuating water table; plants perennial

c. Wet meadow and fen: high altitude marshes with mineral soil (wet meadows) or peat soil (fens) and a seasonally falling water table; plants perennial

d. Vernal pool: medium altitude marshes with mineral soil and a rapidly falling water table; plants annual

VEGETATION

81. Growth forms and physiognomy: usually open to dense stands of

graminoids (grasses and sedges) to 1.8 m tall; occasionally dominated by forbs such as Yellow water lily (*Nuphar polysepalum*).

82. Species composition of the freshwater marsh:

a. Coastal deflation plain:

Dominant species

Beckmannia syzigachne (Slough grass)
Carex hindsii (Hind's sedge)
Carex obnupta (Slough sedge)
Carex senta (Rough sedge)
Eleocharis macrostachya (Creeping spikerush)
Hypericum anagalloides (Bog St. John's wort)
Juncus acuminatus (Small-fruited rush)
Lilaeopsis occidentalis (Lilaeopsis)
Ludwigia palustris (Water purslane)
Lycopus uniflorus (Water horehound)
Paspalum distichum (Knotgrass)
Potentilla anserina (Silverweed)
Ranunculus flammula (Creeping buttercup)
Scirpus spp. (Bulrush)
Typha angustifolia (Narrow-leaf cattail)
Typha domingensis (Cattail)
Typha latifolia (Common cattail)
Veronica scutellaria (Marsh speedwell)

Associated species

Alisma trivialis (Water plantain)
Epilobium adenocaulon (Willow herb)
Epilobium watsonii (Watson's willow herb)
Galium triflorum (Bedstraw)
Holcus lanatus (Velvet grass)
Juncus bolanderi (Bolander's rush)
Juncus leseurii (Salt-rush)
Jussiaea repens (Creeping water primrose)
Mimulus guttatus (Monkey flower)
Nuphar polysepalum (Yellow water lily)
Oenanthe sarmentosa (Oenanthe)
Polygonum hydropiperoides (Water pepper)
Polygonum punctatum (Perennial smartweed)
Potentilla egedii (Pacific silverweed)
Sagittaria spp. (Arrowhead)
Sparganium eurycarpum (Bur-reed)

b. Riparian and lacustrine marsh:

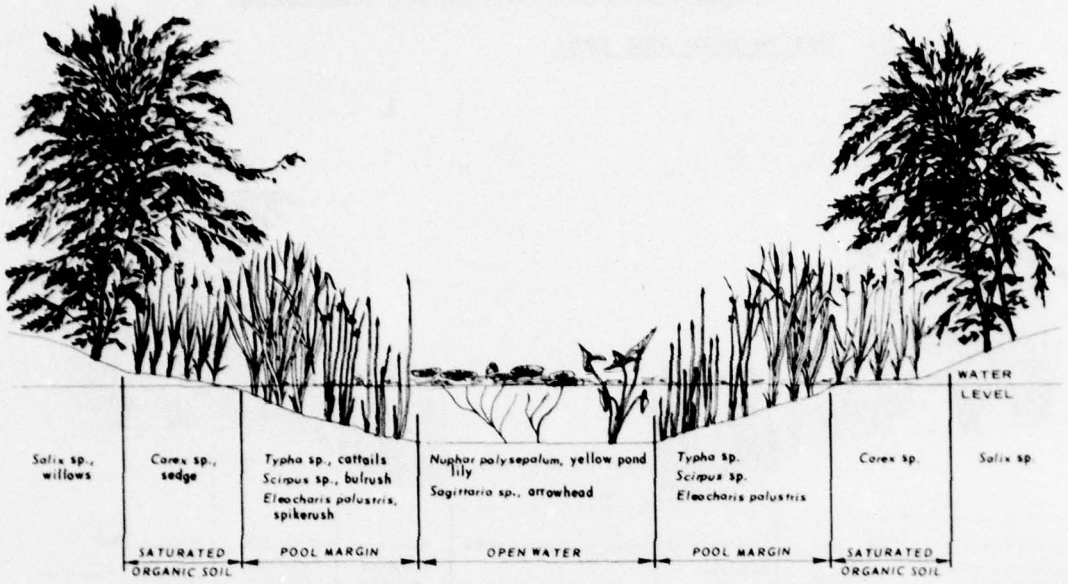

Figure 9. Generalized profile of a freshwater riparian or lacustrine marsh

Dominant species

Deschampsia caespitosa (Tufted hairgrass)
Eleocharis spp. (Spike rush)
Equisetum fluviatile (Water horsetail)
Juncus bufonius (Toad rush)
Juncus supiniformis (Pointed rush)
Nuphar polysepalum (Yellow water lily)
Nymphaea odorata (White water lily)
Paspalum distichum (Knotgrass)
Phalaris arundinacea (Reed canarygrass)
Potentilla palustris (Marsh cinquefoil)
Sagittaria latifolia (Wapato)
Scirpus acutus (Tule)
Scirpus californicus (California bulrush)
Scirpus validus (Softstem bulrush)
Typha latifolia (Common cattail)

Associated species

Alisma spp. (Water plantain)
Bidens cernua (Nodding beggar-tick)
Bergia texana (Bergia)
Capsella bursa-pastoris (Shepherd's purse)
Eichhornia crassipes (Water hyacinth)
Epilobium watsonii (Watson's willow herb)

Limosella aquatica (Mudwort)
Mimulus guttatus (Monkey flower)
Polygonum coccineum (Water smartweed)

c. Wet meadow and fen:

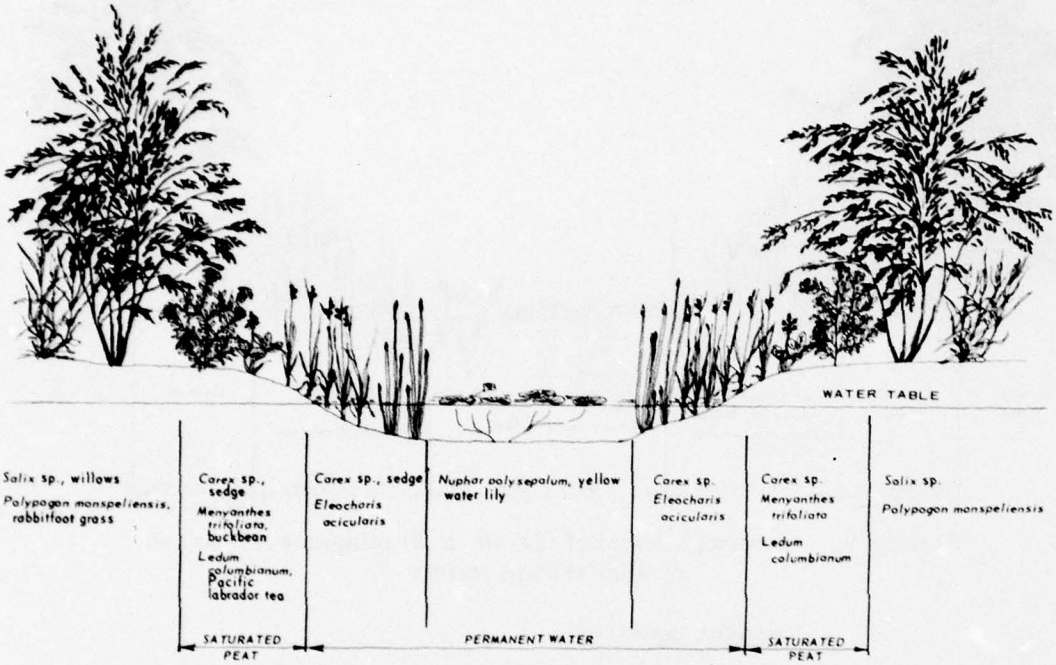

Figure 10. Generalized profile of a freshwater (wet meadow and fen) marsh

Dominant species

Aconitum columbianum (Monkshood)
Calamagrostis nutkaensis (Pacific needle reedgrass)
Caltha biflora (Broad-leaved caltha)
Carex aquatilis (Water sedge)
Carex exserta (Short-hair sedge)
Carex nigricans (Sedge)
Carex rostrata (Beaked sedge)
Carex sitchensis (Sitka sedge)
Carex vesicaria (Inflated sedge)
Deschampsia caespitosa (Tufted hairgrass)
Elymus hirsutus (Wild rye)
Epilobium latifolium (Willow herb)
Mimulus lewisii (Monkey flower)

Associated species

Carex spp. (Sedge)
Eleocharis pauciflora (Spike rush)
Eriophorum spp. (Cottongrass)
Ledum columbianum (Pacific Labrador tea)

Lysichiton americanum (Skunk cabbage)
Menyanthes trifoliata (Buckbean)
Nuphar polysepalum (Yellow water lily)
Pedicularis groenlandica (Elephant's head)
Senecio triangularis (Groundsel)

d. Vernal pool:

Figure 11. Generalized profile of a freshwater (vernal pool) marsh

Dominant species

Callitriche spp. (Water starwort)
Downingia cuspidata (Downingia)
Eleocharis acicularis (Needle spikerush)
Eleocharis obtusa (Blunt spikerush)
Elodea spp. (Waterweed)
Eryngium aristulatum (Button snakeroot)
Isoetes howellii (Quillwort)
Ludwigia palustris (Water purslane)
Pilularia americana (Pillwort)
Plagiobothrys spp. (Popcorn flower)
Pogogyne abramsii (Mesa mint)
Ranunculus aquatilis (Aquatic buttercup)
Veronica peregrina (Speedwell)

Associated species

Alopecurus saccatus (Water foxtail)
Deschampsia danthonioides (Annual hairgrass)
Eleocharis macrostachya (Creeping spikerush)
Juncus bufonius (Toad rush)
Juncus dubius (Mariposa rush)
Juncus triformis (Dwarf rush)
Lilaea scilloides (Flowering quillwort)
Myosurus minimus (Mousetail)
Phalaris lemmonii (Canarygrass)

Dominant and associated species. Deflation plain marshes, as well as several other wetland communities in this coastal region, commonly support Slough sedge (*Carex obnupta*) and Pacific silverweed (*Potentilla egedii*); *Juncus leseurii* is a common associate. Coastal deflation plain marshes in the southern part of the region support cattails, Rough sedge (*Carex aenta*), Bolander's rush (*Juncus bolanderi*), and Salt-rush (*Juncus leseurii*), as well as Velvet grass (*Holcus lanatus*) and *Potentilla* spp. Bur-reed (*Sparganium* spp.) and *Oenanthe* occur with Bulrush (*Scirpus* spp.) in deeper waters.

The most common species in the riparian (stream/river) and lacustrine (pond/lake) marshes are spikerushes (*Eleocharis* spp.), Common tule (*Scirpus acutus*), Wapato (*Sagittaria latifolia*), Softstem bulrush (*Scirpus validus*), Reed canarygrass (*Phalaris arundinacea*), California bulrush (*Scirpus californicus*), Common cattail (*Typha latifolia*), and Knotgrass (*Paspalum distichum*). These marshes occur in areas of slowly moving or slack water with silty bottoms. Although most of the species are rooted, the marshes also support floating species such as Duckweed (*Lemna* spp.) and Water fern (*Azolla* spp.).

Wet meadows and fens are cool montane wetlands typical of areas with peat soil (fens) or mineral soil (wet meadows). Wet meadows are the driest of the freshwater marshes and contain several species that cannot withstand permanently saturated soils. The species composition of wet meadows is affected strongly by local environmental conditons; because it affects snow depth and duration, slope exposure probably is the most influential factor of the microenvironment. Northern valerian, for example, dominates on steep slopes that remain wet from receding snowbanks late in the year; Sitka sedge dominates sites inundated up to three weeks by snow-melt waters. Holm's Rocky Mountain sedge (*Carex scopulorum*) is important, along with Broad-leaved caltha and *Carex lusulina*, on other snow-melt areas that are saturated but not inundated. Wet meadows in the mountainous areas have not been studied thoroughly. They often are associated with mountain streams.

Fens in the West Coast region commonly intergrade with wet meadows. The distinction between fen and wet meadow is based on soil type, whether mineral (wet meadow) or organic (fen), but many areas intergrade. Various sedges (*Carex* spp.) are often dominant; Needle spikerush (*Eleocharis acicularis*) may

share dominance with the sedges to the near exclusion of all other species. Areas with deeper water are characterized by coarse sedges (*Carex nebraskensis* and *C. rostrata*, *Eleocharis pauciflora*, and *Eriophorum* spp.) as the dominant graminoids. Elephant's head (*Pedicularis groenlandica*) and Buckbean (*Menyanthes trifoliata*) are characteristic herbs of fens.

Vernal pools are small, hardpan-floored depressions in grasslands of the Central Valley of California. They once were abundant but now are diminishing rapidly because of urbanization, grazing, and other factors of disturbance. The vegetation in vernal pools changes seasonally with pools filling up with water in the winter and drying out as the spring progresses. The sequence may progress, for example, from *Callitriche* to *Isoetes* and *Pilularia*. As the latter two mature, *Plagiobotrys* develops flowers. The following species develop leaves and flowers above the water surface: *Plagiobotrys acanthocarpus*, *P. bracteatus*, *P. leptocladus*, and *Veronica scutellaria*. Mesa mint (*Pogogyne abramsii*), which grows during the same period, does not flower until the soil dries. Button snakeroot (*Eryngium aristulatum*), also late maturing, completes its life cycle on parched cracking soil. It is difficult to specify the dominants of vernal pools because of these seasonal changes. Usually all of the plants of the pools have died by the end of summer, leaving an unvegetated area with scattered remnants of earlier growth.

Most freshwater marshes are relatively stable successionally. As the landscape gradually changes, so does the vegetation change. For example, as ponds and lakes accumulate silt, the marsh communities are replaced by upland communities, but this process is usually slow unless erosion is accelerated. Wet meadows at times succeed to drier communities as the soil surface becomes raised and the soils dry. Similarly, fens may accumulate sufficient organic matter and mineral soils to become wet meadow, but this process is very slow. Fens also may be replaced by bog vegetation. Vernal pools may be invaded during dry years by more upland species, but these species cannot persist in this habitat. Consequently, this type of marsh is also stable.

Transitional species. Coastal deflation plain marshes are invaded frequently by willows (*Salix* spp.) and Lodgepole pine (*Pinus contorta*), forming a freshwater swamp. Drier areas adjoining deflation plain marshes contain thick stands of Spring bank clover

(*Trifolium willdenovii*) and Brown-headed rush (*Juncus phaeocephalus*).

Riparian and lacustrine marshes usually occupy a zone between freshwater submerged communities and freshwater swamp communities. These marshes generally form a stable community that lies in an intermediate moisture regime between freshwater aquatic and swamp communities. The communities commonly are invaded by willows (*Salix* spp.) as sedimentation raises the surface above the water table.

Wet meadow and fen communities frequently are surrounded by upland forests or by willows. Alpine wet meadows commonly grade into upland or to barren fell-field or lichen-covered rockfields. Freshwater swamps dominated by willow (*Salix* spp.), Red alder (*Alnus oregana*), or conifers commonly border these types of marshes.

The outermost zone of vernal pools is characterized by *Plagiobotrys* spp. and *Deschampsia danthonioides*. Grasses from surrounding areas mix with these species in the driest zones.

ENVIRONMENTAL CONDITIONS

83. The water regime in freshwater marshes varies from permanent inundation in most riparian and lacustrine marshes; to permanently saturated in most fens; to intermittently saturated in the drier wet meadows; to seasonally saturated in deflation plains and vernal pools. The water is slightly acid to alkaline.

84. The soil in deflation plain marshes is sandy and is wet most of the year. The water table fluctuates seasonally with standing water present during the winter rainy season and the water table below the surface during the summer dry season.

85. Riparian and lacustrine wetlands are primarily on wet mineral soil composed of fine sand and silt grading into highly organic muck. These freshwater marsh types are influenced directly by the water level of the adjacent water bodies. Riparian and especially lacustrine wetlands generally have a more stable water table than other freshwater marshes and commonly have standing water throughout the year.

86. Fens and wet meadows on the West Coast generally develop in basins or alluvial valleys. Wet meadows are underlain by sandy loam soil with a definite gley zone. These mineral-soil wetlands have a

fluctuating water table that usually has an oxidized surface and a reduced subsurface soil environment. Fens intergrade with wet meadows and have peat soil with a high calcium/magnesium ratio. These wetlands are mineral rich and commonly have a flow of water through the peat year round.

87. Vernal pools are seasonally flooded depressions that fill rapidly with winter and early spring rains. They usually are dry by May or June due to evaporation, not drainage. The water usually carries little sediment. Accumulation of organic matter frequently results in acidic pools, usually pH 6 to 7, but more acidic conditions are found; occasionally the pools are alkaline. The soil surface is stony with fine particles and is underlain by impermeable clay hardpans.

FIELD IDENTIFICATION

88. Freshwater marshes in the West Coast region are surrounded frequently by either swamps or upland forests. Consequently, the dominance of herbaceous plants is the primary key to the identification of marshes. Coastal deflation plain marshes are located on the windward sides of coastal sand dunes. Riparian and lacustrine marshes are characterized by their landscape position (being adjacent to water bodies). Fens and wet meadows characteristically are mountainous wetlands that lie in local depressions. Vernal pools are typically bare and stony in the winter and dominated by annual plants in the spring and summer months.

FRESHWATER SWAMP

Definition: Wetlands that have more than 40 percent cover by woody plants and are occasionally or regularly flooded by fresh water

89. Freshwater swamps are most common along river courses in the West Coast region. Montane and coastal freshwater swamps occupy local topographic depressions and commonly are associated with freshwater marsh wetlands. These swamps generally occupy either the transition from marsh to upland or the transition from open water to upland.

90. Three major variants of swamp vegetation have been identified in the region:

a. Coastal deflation plain swamp: swamps on wet sandy soil of dune landscapes.

b. Riparian and lacustrine swamp: swamps on mineral soil associated with river or lake floodplains.

c. Montane swamp: swamps occurring in local depressions of upland situations.

91. Riparian and lacustrine swamps are the most common type of freshwater swamp in the region. Freshwater swamps are important in providing wildlife habitat for a variety of birds, mammals, amphibians, and reptiles. These wetlands also contribute organic detritus to adjacent waterways.

VEGETATION

92. Growth forms and physiognomy: open to dense stands of needleleaf trees, such as Western red cedar, and deciduous trees, such as Willow; usually with broadleaf evergreen shrubs, particularly Huckleberry, in the understory.

93. Species composition of the freshwater swamp wetland:

a. Coastal deflation plain swamp

Dominant species

Gaultheria shallon (Salal)
Myrica californica (Wax myrtle)
**Pinus contorta* (Beach pine)

---

* *Pinus contorta* var. *contorta* (Beach pine) is the geographical variety found primarily in coastal regions.

Salix hookeriana (Hooker's willow)
Vaccinium ovatum (California huckleberry)

Associated species

Alnus oregana (Red alder)
Carex obnupta (Slough sedge)
Fragaria chiloensis (Coast strawberry)
Juncus leseurii (Salt rush)
Juncus phaeocephalus (Brown-headed rush)
Picea sitchensis (Sitka spruce)
Spiraea douglasii (Spiraea)

b. Riparian and lacustrine swamp

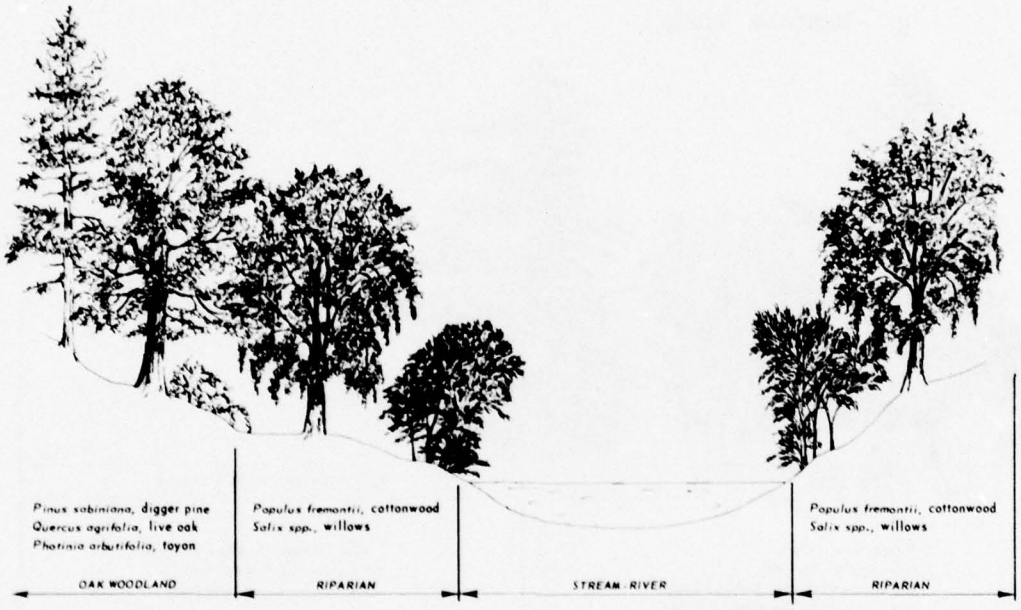

Figure 12. Generalized profile of freshwater riparian swamp

Dominant species

Acer negundo (Box elder)
Alnus oregana (Red alder)
Crataegus douglasii (Black hawthorn)
Fraxinus latifolia (Oregon ash)
Platanus racemosa (Sycamore)
Populus fremontii (Cottonwood)
Populus trichocarpa (Black cottonwood)
Salix spp. (Willow)

Associated species

Agrostis alba (Creeping bentgrass)

Baccharis pilularis (Coyote bush)
Cephalanthus occidentalis (Buttonbush)
Cornus stolonifera (Red-osier dogwood)
Deschampsia caespitosa (Tufted hairgrass)
Equisetum spp. (Horsetail)
Glecoma hederacea (Ground ivy)
Iris pseudacorus (Yellow flag)
Lysichiton americanum (Skunk cabbage)
Lysimachia nummularia (Moneywort)
Phalaris arundinacea (Reed canarygrass)
Rubus spp. (Blackberry)
Sambucus callicarpa (Red elderberry)
Urtica dioica (Stinging nettle)
Vitis californica (Wild grape)

c. Montane swamp

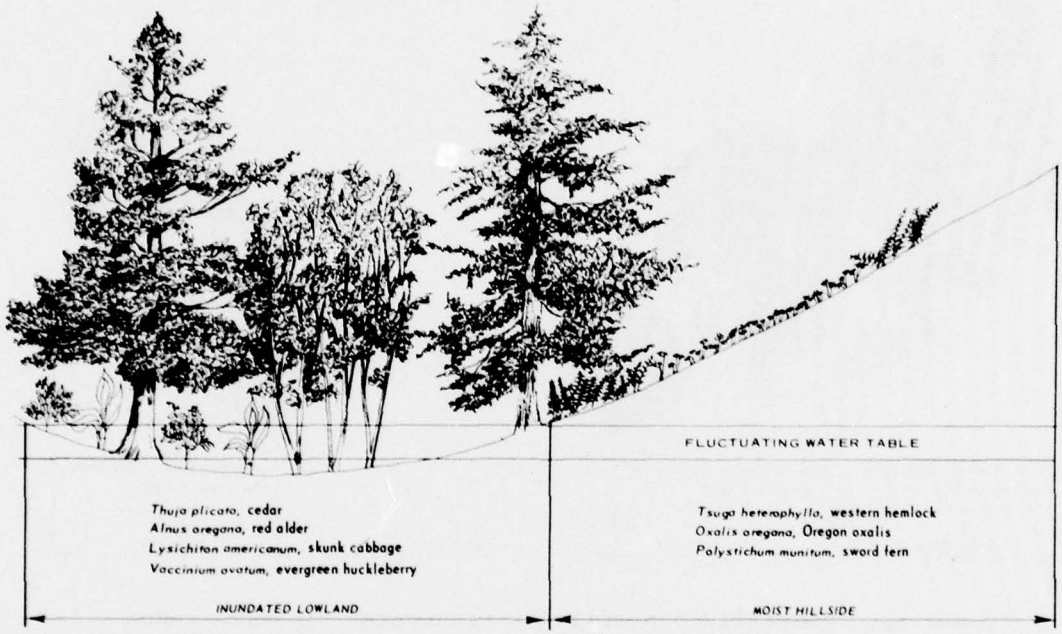

Figure 13. Generalized profile of freshwater montane swamp

Dominant species

Alnus oregana (Red alder)
Empetrum nigrum (Crowberry)
Kalmia polifolia (Mountain laurel)
**Pinus contorta* (Lodgepole pine)
Rhododendron californicum (California rose-bay)
Salix pedicellaris (Bog willow)

---

* *Pinus contorta* var. *murrayana* (Lodgepole pine) occurs primarily in interior montane situations.

Thuja plicata (Western red cedar)
Vaccinium oxycoccus (Cranberry)

Associated species

Alnus sinuata (Sitka alder)
Athyrium filix-femina (Lady fern)
Betula occidentalis (Water birch)
Carex obnupta (Slough sedge)
Carex spp. (Sedge)
Gaultheria shallon (Salal)
Lysichiton americanum (Skunk cabbage)
Menyanthes trifoliata (Buckbean)
Myrica california (Wax myrtle)
Oplopanax horridum (Devil's club)
Polypogon monspeliensis (Rabbit-foot grass)
Potentilla egedii (Pacific silverweed)
Spiraea spp. (Spiraea)
Vaccinium ovatum (California huckleberry)

Dominant and associated species. Deflation plain swamps are characterized by a dense stand of Hooker's willow (*Salix hookeriana*) and Wax myrtle (*Myrica californica*). Beach pine (*Pinus contorta*) commonly dominates older deflation plain swamps. The insectivorous sundews (*Drosera* spp.) and Pitcher plants (*Darlingtonia californica*) occur locally in coastal swamps with organic soils.

Riparian and lacustrine swamps of the West Coast region are characterized by varying mixtures of a relatively few species. Willow (*Salix* spp.) swamps, cottonwood (*Populus* spp.) forests, and alder (*Alnus* spp.) and ash (*Fraxinus latifolia*) forests are all characteristic riparian swamp wetland communities in the region. Commonly there is a gradient from willows, adjacent to standing or flowing water, through ash to cottonwood, which usually is at slightly higher elevations that are inundated less frequently. These stands often have Reed canarygrass (*Phalaris arundinacea*) as the sole species in the understory. Blackberry (*Rubus* spp.), Red elderberry (*Sambucus callicarpa*), and Red-osier dogwood (*Cornus stolonifera*) are common understory shrubs.

Small streams characteristically have a riparian forest of Red alder (*Alnus oregana*) and Scouler's willow (*Salix scouleriana*). Typical understory species in these forests are Creeping bentgrass (*Agrostis alba*) and some weedy grass and forb species.

Riparian forest wetland in the southern portion of the region is dominated by cottonwood (*Populus* spp.), Sycamore (*Platanus racemosa*), willows (*Salix* spp.), and Box elder (*Acer negundo*).

Montane swamps are isolated wetlands either closely associated with streams or occurring as local depressions in the landscape, collecting and storing run-off waters. These wetlands have not been well described for the West Coast region. Commonly they are dominated by Western red cedar (*Thuja plicata*), Red alder (*Alnus oregana*), and Willow (*Salix* spp.) with Salal (*Gaultheria shallon*) and California huckleberry as dominant understory shrubs. Skunk cabbage (*Lysichiton americanum*), Slough sedge (*Carex obnupta*), and Lady fern (*Athyrium filix-femina*) are the most common herbs. Most of the trees associated with montane swamps are not obligate wetland species.

Successional trends. Coastal deflation plain swamps have been described as succeeding to forests of spruce or pine. Riparian forests are successionally stable except as river geomorphology slowly changes. The montane swamps may gradually be invaded and replaced by Red alder (*Alnus oregana*), Western hemlock (*Tsuga heterophylla*), Sword fern (*Polystichum munitum*), and Oregon oxalis (*Oxalis oregana*).

Transitional species. Coastal deflation plain swamps border marshes or adjacent upland plant communities. The riparian community may border streams and rivers directly or may be separated by a narrow band of freshwater marsh or freshwater flat. The border between swamps and other wetlands usually is distinct, because the other wetland types have little, if any, cover by woody plant species. The transition to upland usually is to other forest types that lack the typically riparian species. The transition of montane swamps to upland communities is usually abrupt with sharp distinctions between the wetland and adjacent conifer forests.

ENVIRONMENTAL CONDITIONS

94. Deflation plain swamps occur on dune landscapes where the sand has been blown adjacent to the local water table. These wetlands commonly are flooded in the winter and dry during the summer; the water table, however, seldom is more than 0.3 m below the surface.

95. Riparian and lacustrine swamps are characterized by silty to sandy alluvial soil and are flooded seasonally. These wetlands generally occur around stream, river, pond, or lake margins; the water table seldom falls substantially below the surface.

96. Montane swamps grow in saturated soil and occasionally have standing water. The soils of the montane swamps can be either mineral or organic (peat).

FIELD IDENTIFICATION

97. Swamps can be separated from other wetland types by the dominance of trees. The distinction between swamps and upland forests is made on the basis of species composition. Oregon ash (*Fraxinus latifolia*), Black cottonwood (*Populus trichocarpa*), willow (*Salix* spp.), Red alder (*Alnus oregana*), or Western red cedar (*Thuja plicata*) usually identify sites as freshwater swamps. The composition of the understory also should be used to identify freshwater swamps, as several of the dominants are indicative of the wetland habitat.

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APPENDIX A: SCIENTIFIC AND COMMON NAMES OF PLANTS OF THE WEST COAST

Scientific/Common Names

Acer negundo L.
Box-elder
Achillea millefolium L.
Yarrow
Aconitum columbinum Nutt.
Monkshood
Agardhiella spp.
Red alga
Agrostis alba L.
Creeping bentgrass
Alaria spp.
Brown alga
Alisma spp.
Water plantain
Alisma trivialis Pursh
Water plantain
Alnus oregana Nutt.
Red alder
Alnus sinuata (Redgel) Rydb.
Sitka alder
Alopecurus saccatus Vasey
Water foxtail
Athyrium filix-femina (L.) Roth
Lady fern
Atriplex patula L.
Fat-hen
Azolla filiculoides Lam.
Water fern
Baccharis pilularia DC.
Coyote bush
Batis maritima L.
Saltwort
Beckmannia syzigachne (Steud.) Fern.
Slough grass
Bergia texana (Hook.) Seub.
Bergia
Betula occidentalis Hook.
Water birch
Bidens cernua L.
Nodding beggar's-tick
C. senta Boott
Rough sedge
Cakile maritima Scop.
Sea rocket

Calamogrostis nutkaensis (Presl) Streud.
Pacific needle reedgrass
Callitriche longipedunculata Morong
Water starwort
Callitriche spp.
Water starwort
Caltha biflora DC.
Broad-leaved caltha
Capsella bursa-pastoris (L.) Medic.
Shepherd's purse
Carex aquatilis Wahl.
Water sedge
Carex exserta Mackenz.
Short-hair sedge
Carex hindsii Clarke
Hind's sedge
Carex luzulina Olney
Luzula-like sedge
Carex lyngbyei Hornem.
Lyngbye's sedge
Carex nebrascensis Dewey
Caric-sedge
Carex nigricans C. A. Mey.
Caric-sedge
Carex obnupta L. H. Bailey
Slough sedge
Carex rostrata Stokes ex With.
Beaked sedge
Carex scopulorum Holm
Holm's Rocky Mt. sedge
Carex sitchensis Prescott
Sitka sedge
Carex vesicaria L.
Inflated sedge
Ceratophyllum demersum L.
Hornwort
Chara spp.
Stonewort
Chenopodium ambrosioides L.
Mexican tea
Cladophora spp.
Green alga
Codium spp.
Green alga
Cordylanthus maritimus Nutt.
Bird's beak
Cornus stolonifera Michx.
Red-osier dogwood
Cotula coronopifolia L.
Brass buttons
Crataegus douglasii Lindl.
Black hawthorn

Cuscuta salina Engelm.
Dodder
Darlingtonia californica Torr.
Pitcher plant
Deschampsia caespitosa (L.) Beauv.
Tufted hairgrass
Deschampsia danthonioides (Trin.) Munro ex Roth
Annual hairgrass
Distichlis spicata (L.) Greene
Saltgrass
Downingia cuspidata (Greene) Greene
Downingia
Drosera spp.
Sundew
Echinochloa crus-galli(L.) Beauv.
Barnyard grass
Eichhornia crassipes (Mart.) Solms.
Water hyacinth
Eleocharis acicularis (L.) R. & S.
Needle spikerush
Eleocharis macrostachya Britt.
Creeping spikerush
Eleocharis obtusa (Wild.) Schult.
Blunt spikerush
Eleocharis parvula (R. & S.) Link
Spikerush
Eleocharis pauciflora (Lightf.) Link
Spikerush
Elodea canadensis Michx.
Waterweed
Elodea nuttallii (Planch.) St. John
Waterweed
Elymus glaucus Buckl.
Wild rye
Elymus hirsutus Presl
Wild rye
Empetrum nigrum L.
Crowberry
Enteromorpha spp.
Green alga
Epilobium adenocaulon Hausskn.
Willow herb
Epilobium latifolium L.
Willow herb
Epilobium watsonii Barb.
Watson's willow herb
Equisetum fluviatile L.
Water horsetail
Equisetum spp.
Horsetail

Eriophorum spp.
Cottongrass
Eryngium aristulatum Jeps.
Button snakeroot
Fragaria chiloensis (L.) Duchn.
Coast strawberry
Frankenia grandifolia Cham. & Schlecht.
Frankenia
Fraxinus latifolia Benth.
Oregon ash
Fucus spp.
Brown alga
Galium triflorum Michx.
Bedstraw
Gaultheria shallon Pursh
Salal
Glaux maritima L.
Sea milkwort
Glecoma hederacea L.
Ground ivy
Grindelia spp.
Gum plant
Hibiscus californicus Kell.
California hibiscus
Holcus lanatus L.
Velvet grass
Hordeum jubatum L.
Foxtail barley
Hydrocotyle verticillata Thunb.
Marsh pennywort
Hymenena spp.
Red alga
Hypericum anagalloides Cham. & Schlecht.
Bog St. John's wort
Iridaea spp.
Brown alga
Iris pseudacorus L.
Yellow flag
Isoetes howellii Engelm.
Quillwort
Jaumea carnosa (Less) Gray
Jaumea
Juncus acuminatus Michx.
Small-fruited rush
Juncus balticus Willd.
Baltic rush
Juncus bolanderi Engelm.
Bolander's rush
Juncus bufonius L.
Toad rush

Juncus dubius Engelm.
Mariposa rush
Juncus effusus L.
Common rush
Juncus lesuerii Bol.
Salt-rush
Juncus phaeocephalus Engelm.
Brown-headed rush
Juncus supiniformis Engelm.
Pointed rush
Juncus triformis Engelm.
Dwarf rush
Jussiaea repens L.
Creeping water primrose
Kalmia polifolia Wang.
Mountain laurel
Laminaria spp.
Brown alga
Ledum columbianum Piper
Pacific Labrador-tea
Lemna perpusilla Torr.
Duckweed
Lemna trisulca L.
Duckweed
Lilaea scilloides (Poir.) Haum.
Flowering quillwort
Lilaeopsis occidentalis Coult. & Rose
Lilaeopsis
Limonium californicum (Boiss.) Heller
Sea lavender
Limosella aquatica L.
Mudwort
Limosella subulata Ives
Mudwort
Lonicera involucrata (Richards.) Banks
Twinberry
Ludwigia palustris (L.) Ell.
Water purslane
Lycopus uniflorus Michx.
Water horehound
Lyngbya spp.
Bluegreen alga
Lysichiton americanum Hult. & St. John
Skunk cabbage
Lysimachia nummularia L.
Moneywort
Macrocystis spp.
Brown alga
Menyanthes trifoliata L.
Buckbean

Mimulus guttatus Fisch.
Monkey flower
Mimulus lewisii Pursh
Monkey flower
Monanthochloe littoralis Engelm.
Shoregrass
Mougeotiopsis spp.
Green alga
Myosurus minimus L.
Mousetail
Myrica californica Cham. & Schlecht.
Wax myrtle
Myriophyllum spicatum L.
Water milfoil
Najas spp.
Water nymph
Nasturtium officinale R. Br.
Water cress
Nereocystis spp.
Brown alga
Nuphar polysepalum Engelm.
Yellow water lily
Nymphaea odorata Aiton
White water lily
Oenanthe sarmentosa Presl
Oenanthe
Oplopanax horridum (J. E. Smith) Moq.
Devil's club
Oscillatoria spp.
Blue-green alga
Paspalum distichum L.
Knotgrass
Pedicularis groenlandica Retz.
Elephant's head
Phalaris arundinacea L.
Reed canarygrass
Phalaris lemmonii Vasey
Canarygrass
Phragmites communis Trin.
Common reed
Phyllospadix scouleri Hook.
Surf-grass
Picea sitchensis (Bong.) Carr.
Sitka spruce
Pilularia americana A. Br.
Pillwort
Pinus contorta Dougl.
Lodgepole pine
Plagiobothrys acanthocarpus (Piper) Jtn.
Popcorn flower

Plagiobothrys bracteatus (Howell) Jtn.
Bracted allocarya
Plagiobothrys leptocladus (Greene) Jtn.
Smooth-stemmed allocarya
Plagiobothrys reticulatus (Piper) Jtn.
Netted allocarya
Plantago maritima L.
Goosetongue
Platanus racemosa Nutt.
Sycamore
Poa spp.
Bluegrass
Pogogyne abramsii J. T. Howell
Mesa mint
Polygonum coccineum Muhl.
Water smartweed
Polygonum hydropiper L.
Marsh pepper
Polygonum hydropiperoides Michx.
Water pepper
Polygonum punctatum Ell.
Perennial smartweed
Polypogon monspeliensis (L.) Desf.
Rabbit-foot grass
Populus fremontii Wats.
Cottonwood
Populus trichocarpa T. & G.
Black cottonwood
Potamogeton berchtoldii Feib.
Pondweed
Potamogeton epihydrus Raf.
Pondweed
Potamogeton pectinatus L.
Sago pondweed
Potamogeton richardsonii (Benn.) Rydb.
Pondweed
Potamogeton robbinsii Oakes
Pondweed
Potentilla anserina L.
Silverweed
Potentilla egedei Wormsk.
Pacific silverweed
Potentilla palustris (L.) Scop.
Marsh cinquefoil
Potomogeton spp.
Pondweed
Protococcus spp.
Green alga
Pterygophora spp.
Brown alga

Puccinellia pumila (Vas.) C. Hitchc.
Alkali grass
Ranunculus aquatilis L.
Asiatic buttercup
Ranunculus flammula L.
Creeping buttercup
Rhododendron macrophyllum D. Don
California rose-bay
Rubus spp.
Blackberry
Rumex acetosella L.
Sheep sorrel
Rumex crispus L.
Curly dock
Ruppia maritima L.
Widgeon grass
Sagittaria latifolia Willd.
Wapato
Sagittaria spp.
Arrowhead
Salicornia bigelovii Torr.
Bigelow's pickleweed
Salicornia subterminalis Parish.
Subterminal pickleweed
Salicornia virginica L.
Glasswort
Salix gooddingii Ball
Gooding's willow
Salix hindsiana Benth.
Sandbar willow
Salix hookeriana Barr.
Hooker's willow
Salix lasiandra Benth.
Black willow
Salix pedicellaris Pursh
Bog willow
Salix scouleriana Barr.
Scouler's willow
Sambucus callicarpa Greene
Red elderberry
Samolus parviflorus Raf.
Water pimpernel
Scirpus acutus Muhl.
Tule
Scirpus americanus Pers.
Three-square bulrush
Scirpus californicus (C. A. Mey) Steud.
California bulrush
Scirpus olneyi Gray
Olney's bulrush

Scirpus robustus Pursh
Bull tule
Scirpus validus Vahl
Softstem bulrush
Senecio triangularis Hook.
Groundsel
Sparganium eurycarpum Engelm.
Bur-reed
Sparganium spp.
Bur-reed
Spartina foliosa Trin.
Cordgrass
Spergularia canadensis (Pers.) G. Don
Sand spurry
Spergularia macrotheca (Hornem.) Heynh.
Sand spurry
Spergularia marina (L.) Griseb.
Sand spurry
Spiraea douglasii Hook.
Spiraea
Thuja plicata Donn
Western red cedar
Tillaea aquatica L.
Water stonecrop
Trifolium willdenovii Lehm.
Spring bank clover
Trifolium wormskjoldii Lehm.
Coast clover
Triglochin maritima L.
Sea arrowgrass
Typha angustifolia L.
Narrow-leaf cat-tail
Typha domingensis Pers.
Cat-tail
Typha latifolia L.
Common cat-tail
Ulva spp.
Sea lettuce
Urtica spp.
Stinging nettle
Vaccinium ovatum Pursh
California huckleberry
Vaccinium oxycoccus L.
Cranberry
Veronica peregrina L.
Speedwell
Veronica scutellata L.
Marsh speedwell
Vitis californica Benth.
Wild grape

Xanthium spp.
Cocklebur
Zostera spp.
Eelgrass

Common/Scientific Names

Alkali grass
Puccinellia pumila (Vas.) C. Hitchc.
Annual hairgrass
Deschampsia danthonioides (Trin.) Munro ex Roth
Arrowhead
Sagittaria spp.
Asiatic buttercup
Ranunculus aquatilis L.
Baltic rush
Juncus balticus Willd.
Barnyard grass
Echinochloa crus-galli(L.) Beauv.
Beaked sedge
Carex rostrata Stokes ex With.
Bedstraw
Galium triflorum Michx.
Bergia
Bergia texana (Hook.) Seub.
Bigelow's pickleweed
Salicornia bigelovii Torr.
Bird's beak
Cordylanthus maritimus Nutt.
Black cottonwood
Populus trichocarpa T. & G.
Black hawthorn
Crataegus douglasii Lindl.
Black willow
Salix lasiandra Benth.
Blackberry
Rubus spp.
Blue-green alga
Oscillatoria spp.
Bluegrass
Poa spp.
Bluegreen alga
Lyngbya spp.
Blunt spikerush
Eleocharis obtusa (Wild.) Schult.
Bog St. John's wort
Hypericum anagalloides Cham. & Schlecht.
Bog willow
Salix pedicellaris Pursh
Bolander's rush
Juncus bolanderi Engelm.
Box-elder
Acer negundo L.
Bracted allocarya
Plagiobothrys bracteatus (Howell) Jtn.

Brass buttons
Cotula coronopifolia L.
Broad-leaved caltha
Caltha biflora DC.
Brown alga
Alaria spp.
Brown alga
Fucus spp.
Brown alga
Iridaea spp.
Brown alga
Laminaria spp.
Brown alga
Macrocystis spp.
Brown alga
Nereocystis spp.
Brown alga
Pterygophora spp.
Brown-headed rush
Juncus phaeocephalus Engelm.
Buckbean
Menyanthes trifoliata L.
Bull tule
Scirpus robustus Pursh
Bur-reed
Sparganium eurycarpum Engelm.
Bur-reed
Sparganium spp.
Button snakeroot
Eryngium aristulatum Jeps.
California bulrush
Scirpus californicus (C. A Mey) Steud.
California hibiscus
Hibiscus californicus Kell.
California huckleberry
Vaccinium ovatum Pursh
California rose-bay
Rhododendron macrophyllum D. Don
Canarygrass
Phalaris lemmonii Vasey
Caric-sedge
Carex nebrascensis Dewey
Caric-sedge
Carex nigricans C. A. Mey.
Cat-tail
Typha domingensis Pers.
Coast clover
Trifolium wormskjoldii Lehm.
Coast strawberry
Fragaria chiloensis (L.) Duchn.

Cocklebur
Xanthium spp.
Common cat-tail
Typha latifolia L.
Common reed
Phragmites communis Trin.
Common rush
Juncus effusus L.
Cordgrass
Spartina foliosa Trin.
Cottongrass
Eriophorum spp.
Cottonwood
Populus fremontii Wats.
Coyote bush
Baccharis pilularia DC.
Cranberry
Vaccinium oxycoccus L.
Creeping bentgrass
Agrostis alba L.
Creeping buttercup
Ranunculus flammula L.
Creeping spikerush
Eleocharis macrostachya Britt.
Creeping water primrose
Jussiaea repens L.
Crowberry
Empetrum nigrum L.
Curly dock
Rumex crispus L.
Devil's club
Oplopanax horridum (J. E. Smith) Moq.
Dodder
Cuscuta salina Engelm.
Downingia
Downingia cuspidata (Greene) Greene
Duckweed
Lemna perpusilla Torr.
Duckweed
Lemna trisulca L.
Dwarf rush
Juncus triformis Engelm.
Eelgrass
Zostera spp.
Elephant's head
Pedicularis groenlandica Retz.
Fat-hen
Atriplex patula L.
Flowering quillwort
Lilaea scilloides (Poir.) Haum.

Foxtail barley
Hordeum jubatum L.
Frankenia
Frankenia grandifolia Cham. & Schlecht.
Glasswort
Salicornia virginica L.
Gooding's willow
Salix gooddingii Ball
Goosetongue
Plantago maritima L.
Green alga
Cladophora spp.
Green alga
Codium spp.
Green alga
Enteromorpha spp.
Green alga
Mougeotiopsis spp.
Green alga
Protococcus spp.
Ground ivy
Glecoma hederacea L.
Groundsel
Senecio triangularis Hook.
Gum plant
Grindelia spp.
Hind's sedge
Carex hindsii Clarke
Holm's Rocky Mt. sedge
Carex scopulorum Holm
Hooker's willow
Salix hookeriana Barr.
Hornwort
Ceratophyllum demersum L.
Horsetail
Equisetum spp.
Inflated sedge
Carex vesicaria L.
Jaumea
Jaumea carnosa (Less) Gray
Knotgrass
Paspalum distichum L.
Lady fern
Athyrium filix-femina (L.) Roth
Lilaeopsis
Lilaeopsis occidentalis Coult. & Rose
Lodgepole pine
Pinus contorta Dougl.
Luzula-like sedge
Carex luzulina Olney

Lyngbye's sedge
Carex lyngbyei Hornem.
Mariposa rush
Juncus dubius Engelm.
Marsh cinquefoil
Potentilla palustris (L.) Scop.
Marsh pennywort
Hydrocotyle verticillata Thunb.
Marsh pepper
Polygonum hydropiper L.
Marsh speedwell
Veronica scutellata L.
Mesa mint
Pogogyne abramsii J. T. Howell
Mexican tea
Chenopodium ambrosioides L.
Moneywort
Lysimachia nummularia L.
Monkey flower
Mimulus guttatus Fisch.
Monkey flower
Mimulus lewisii Pursh
Monkshood
Aconitum columbinum Nutt.
Mountain laurel
Kalmia polifolia Wang.
Mousetail
Myosurus minimus L.
Mudwort
Limosella aquatica L.
Mudwort
Limosella subulata Ives
Narrow-leaf cat-tail
Typha angustifolia L.
Needle spikerush
Eleocharis acicularis (L.) R. & S.
Netted allocarya
Plagiobothrys reticulatus (Piper) Jtn.
Nodding beggar's-tick
Bidens cernua L.
Oenanthe
Oenanthe sarmentosa Presl
Olney's bulrush
Scirpus olneyi Gray
Oregon ash
Fraxinus latifolia Benth.
Pacific Labrador-tea
Ledum columbianum Piper
Pacific needle reedgrass
Calamogrostis nutkaensis (Presl) Streud.

Pacific silverweed
Potentilla egedei Wormsk.
Perennial smartweed
Polygonum punctatum Ell.
Pillwort
Pilularia americana A. Br.
Pitcher plant
Darlingtonia californica Torr.
Pointed rush
Juncus supiniformis Engelm.
Pondweed
Potamogeton berchtoldii Feib.
Pondweed
Potamogeton epihydrus Raf.
Pondweed
Potamogeton richardsonii (Benn.) Rydb.
Pondweed
Potamogeton robbinsii Oakes
Pondweed
Potomogeton spp.
Popcorn flower
Plagiobothrys acanthocarpus (Piper) Jtn.
Quillwort
Isoetes howellii Engelm.
Rabbit-foot grass
Polypogon monspeliensis (L.) Desf.
Red alder
Alnus oregana Nutt.
Red alga
Agardhiella spp.
Red alga
Hymenena spp.
Red elderberry
Sambucus callicarpa Greene
Red-osier dogwood
Cornus stolonifera Michx.
Reed canarygrass
Phalaris arundinacea L.
Rough sedge
C. senta Boott
Sego pondweed
Potamogeton pectinatus L.
Salal
Gaultheria shallon Pursh
Salt-rush
Juncus lesuerii Bol.
Saltgrass
Distichlis spicata (L.) Greene
Saltwort
Batis maritima L.

Sand spurry
Spergularia canadensis (Pers.) G. Don
Sand spurry
Spergularia macrotheca (Hornem.) Heynh.
Sand spurry
Spergularia marina (L.) Griseb.
Sandbar willow
Salix hindsiana Benth.
Scouler's willow
Salix scouleriana Barr.
Sea arrowgrass
Triglochin maritima L.
Sea lavender
Limonium californicum (Boiss.) Heller
Sea lettuce
Ulva spp.
Sea milkwort
Glaux maritima L.
Sea rocket
Cakile maritima Scop.
Sheep sorrel
Rumex acetosella L.
Shepherd's purse
Capsella bursa-pastoris (L.) Medic.
Shoregrass
Monanthochloe littoralis Engelm.
Short-hair sedge
Carex exserta Mackenz.
Silverweed
Potentilla anserina L.
Sitka alder
Alnus sinuata (Redgel) Rydb.
Sitka sedge
Carex sitchensis Prescott
Sitka spruce
Picea sitchensis (Bong.) Carr.
Skunk cabbage
Lysichiton americanum Hult. & St. John
Slough grass
Beckmannia syzigachne (Steud.) Fern.
Slough sedge
Carex obnupta L. H. Bailey
Small-fruited rush
Juncus acuminatus Michx.
Smooth-stemmed allocarya
Plagiobothrys leptocladus (Greene) Jtn.
Softstem bulrush
Scirpus validus Vahl
Speedwell
Veronica peregrina L.

Spikerush
Eleocharis parvula (R. & S.) Link
Spikerush
Eleocharis pauciflora (Lightf.) Link
Spiraea
Spiraea douglasii Hook.
Spring bank clover
Trifolium willdenovii Lehm.
Stinging nettle
Urtica spp.
Stonewort
Chara spp.
Subterminal pickleweed
Salicornia subterminalis Parish.
Sundew
Drosera spp.
Surf-grass
Phyllospadix scouleri Hook.
Sycamore
Platanus racemosa Nutt.
Three-square bulrush
Scirpus americanus Pers.
Toad rush
Juncus bufonius L.
Tufted hairgrass
Deschampsia caespitosa (L.) Beauv.
Tule
Scirpus acutus Muhl.
Twinberry
Lonicera involucrata (Richards.) Banks
Velvet grass
Holcus lanatus L.
Wapato
Sagittaria latifolia Willd.
Water birch
Betula occidentalis Hook.
Water cress
Nasturtium officinale R. Br.
Water fern
Azolla filiculoides Lam.
Water foxtail
Alopecurus saccatus Vasey
Water horehound
Lycopus uniflorus Michx.
Water horsetail
Equisetum fluviatile L.
Water hyacinth
Eichhornia crassipes (Mart.) Solms.
Water milfoil
Myriophyllum spicatum L.

Water nymph
Najas spp.
Water pepper
Polygonum hydropiperoides Michx.
Water pimpernel
Samolus parviflorus Raf.
Water plantain
Alisma spp.
Water plantain
Alisma trivialis Pursh
Water purslane
Ludwigia palustris (L.) Ell.
Water sedge
Carex aquatilis Wahl.
Water smartweed
Polygonum coccineum Muhl.
Water starwort
Callitriche longipedunculata Morong
Water starwort
Callitriche spp.
Water stonecrop
Tillaea aquatica L.
Waterweed
Elodea canadensis Michx.
Waterweed
Elodea nuttallii (Planch.) St. John
Watson's willow herb
Epilobium watsonii Barb.
Wax myrtle
Myrica californica Cham. & Schlecht.
Western red cedar
Thuja plicata Donn
White water lily
Nymphaea odorata Aiton
Widgeon grass
Ruppia maritima L.
Wild grape
Vitis californica Benth.
Wild rye
Elymus glaucus Buckl.
Wild rye
Elymus hirsutus Presl
Willow herb
Epilobium adenocaulon Hausskn.
Willow herb
Epilobium latifolium L.
Yarrow
Achillea millefolium L.
Yellow flag
Iris pseudacorus L.
Yellow water lily
Nuphar polysepalum Engelm.

APPENDIX B: GLOSSARY

ABUNDANCE: a term used in quantitative vegetation sampling, referring to density of a given species per unit area; usually expressed as the total number of individual organisms in a unit area.

ACIDIC: having a pH value of less than 7, nonalkaline.

ALGAE: a nonvascular chlorophyll-bearing organism, common to various types of wetlands and very important in productivity.

ALKALINE: having a pH value greater than 7, nonacidic.

ANGIOSPERM: a plant characterized by flowers and seeds enclosed in fruits; e.g., orchids, palms, oaks, etc.

ANNUAL: a plant in which the entire life cycle is completed in a single growing season.

AQUATIC VEGETATION: a plant characteristically growing wholly or partly submerged in water.

AUTHORITY: the name of the person or persons who first described a particular plant to science, appearing in conjunction with a scientific name; e.g., *Typha latifolia* L. (the L. representing the botanist Linnaeus).

BACKWATER: an accumulation of usually quiet water, held back by a natural dike, high tides, or unusually high water levels in creeks, rivers, or lakes.

BANANA HOLE: type of freshwater swamp occurring in small sinkholes in Florida.

BARRIER ISLAND: an offshore island, similar to a bar, except with ridges, vegetation, and swampy tracts.

BAY: a body of water, smaller than a gulf, located in a recess in the shoreline.

BAYHEAD: a regicnal name applied to a type of freshwater swamp in Florida, dominated by a mixture of hardwood species.

BAYOU: a small, sluggish secondary stream or lake, often existing as an area of backwater in an abandoned channel.

BIENNIAL: a plant normally requiring two growing seasons to complete its life cycle; vegetative growth appears the first year and flowering and fruiting follow in the second year.

BOG: a vegetation type usually denoting an area of wet, acid peat.

BRACKISH: referring to water or soils having salinity contents of 0.5 to 30 ppt (o/oo).

BROADLEAF: having broad, flat leaves; usually referring to angiosperms (flowering plants) as contrasted with the needle-leaves of many gymnosperms.

CARR: a poorly defined regional wetland term, used primarily in parts of the Midwest; refers to a successional community (dominated by shrubs) that appears between marsh and swamp formation.

CLIMAX: the terminal community of a particular plant succession sequence, maintaining itself relatively unchanged unless the environment changes.

COASTAL FLAT: wetland type having 25 percent or less vegetative cover and that is occasionally or regularly flooded by saline water of tidal origin.

COLONY: a group of organisms of the same species growing in a localized area, often used to refer to a group of plants becoming established in a new situation.

COMMUNITY: a distinctive combination of two or more ecologically related species, living together and interacting with each other in a characteristic natural habitat.

CONIFER: a common term for any gymnosperm of the order Coniferales (the group containing those gymnosperms producing definite cones, as pine, spruce, etc.).

COVER: a term used in quantitative vegetation sampling, referring to the amount (percent) of ground with vegetation above it; estimated by vertically projecting the outline of the crown onto the ground.

dbh: diameter (of a tree) at breast height.

DECIDUOUS: shedding of leaves at end of growing season (or sometimes, in the Southwest, under periods of environmental stress before the end of the growing season); usually referring to broad-leaved woody angiosperms (flowering plants) but sometimes referring to gymnosperms (e.g., Bald cypress).

DEFLATION PLAIN BASIN: a basin formed in arid areas by removal of loose material from an area by wind.

DETRITAL: referring to dead organic tissues, decomposed material, and organisms in an ecosystem; usually including the live microorganisms involved in the decomposition of the material.

DISCLIMAX: a potentially long-persisting and self-reproducing vegetation type, maintaining its composition and structure only as a consequence of continuing disturbance (as by fire, grazing, etc.).

DOMINANT: a prevailing species of an area; a species that to a considerable extent controls the conditions for existence of its associates within an ecosystem.

DWARF SHRUB: woody plants characterized by numerous stems and rarely exceeding 50 cm in height.

ECOTONE: the transition zone between two or more adjacent plant communities, usually containing species from each of the adjacent vegetation types.

EMERSED: standing out above the water, as the leaves of certain hydrophytes.

EMERGENT: same as EMERSED.

EPIPHYTE: a plant that grows on another plant for support but is not parasitic on it.

ESTUARY: a basin in which river water mixes with and dilutes sea water.

EVERGREEN: a perennially green plant, never losing all its leaves at one time.

FEN: a poorly defined regional term for a type of marsh; usually said to be formed on peat that is circumneutral or alkaline in pH; vegetation marked by high species diversity; equivalent to the sedge-meadow of many authors.

FLOATING-LEAVED COMMUNITY: an aquatic assemblage dominated by species having leaves that float on the water surface, often floating by virtue of long flexuous petioles (such as most water lilies).

FLORA: the vegetation of an area; also used to denote a book for identification of plant species in an area.

FORBS: associated herbaceous species other than grasses; term used in ecological description of nonwoody vegetation.

FREQUENCY: a term used in quantitative vegetation sampling, relating to the number of times a species occurs in a given number of sample plots; expressed as a fraction of the total, usually in percent.

FRESH WATER: water containing less than 0.5 ppt (o/oo) salinity.

FRESHWATER AQUATIC COMMUNITY: a wetland dominated by free-floating or rooted aquatic herbs and that is semipermanently or permanently flooded by fresh water (e.g., a patch of water lilies).

FRESHWATER INLAND FLAT: a wetland having less than 25 percent vegetative cover and that is occasionally or regularly flooded by fresh water (e.g., mudflats).

FRESHWATER MARSH: a wetland having more than 25 percent vegetative cover by terrestrial herbs but 40 percent or less cover by woody plants, occasionally or regularly flooded by fresh water (e.g., sawgrass prairie).

FRESHWATER SWAMP: a wetland having more than 40 percent cover by woody plants and that is occasionally or regularly flooded by fresh water (e.g., cypress swamp).

GENUS (plural GENERA): a taxonomic category that represents a group of closely related species (e.g., all kinds of cattail are placed in the single genus *Typha*).

GRAMINOID: a term referring to grasses or grasslike plants (including the grasses, sedges, rushes, etc.).

GRASS-SEDGE BOG: a wet peatland dominated by grasses and sedges.

GROUNDWATER: water contained in rocks below the water table.

GROWTH FORM: a descriptive concept of vegetation based on some particular characteristic, such as deciduous versus evergreen and broad-leaf versus needle-leaf.

GUT: a narrow inlet of water along a coastline.

GYMNOSPERM: any of a number of different kinds of woody seed-plants in which the seeds are not enclosed in a fruit (e.g., pine, cedar, etc.).

HALOPHYTE: any plant species capable of tolerating salinity levels of more than 0.5 ppt (o/oo).

HAMMOCK: a dense growth of broad-leaved trees on a slight elevation; not considered wet enough to be a swamp.

HARDPAN: a hard, impervious subsurface layer of clay soil, usually impervious to both water and root penetration.

HARDWOOD: a broad-leaved angiosperm (flowering plant) tree having wood characterized by the presence of specialized cells called vessels.

HERB: a nonwoody plant--annual, biennial, or perennial--whose aboveground parts are short lived (in temperate regions, only one growing season).

HERBACEOUS: the adjective used to describe plants that are herbs.

HYDRIC: aquatic.

HYDROPHYTE: a plant growing in water or in characteristically wet soil.

HYPERSALINE: soil or water with a high salt content.

IMPOUNDMENT: standing body of open water created by artifically blocking or restricting the flow of a river, stream, or tidal area.

INTERMITTENT STREAM: a stream receiving its water primarily from surface runoff.

INTERTIDAL ZONE: in coastal areas, the region between levels of high tide and low tide.

KARST TOPOGRAPHY: a topography formed over limestone, dolomite, or gypsum and characterized by sinkholes, caves, and underground drainage.

KELP: any of the various large, coarse brown seaweeds (brown algae) of marine waters.

LACUSTRINE: pertaining to a lake.

LAGOON: a shallow coastal body of water, partly separated from the sea by beaches or islands; usually a lagoon is elongate and parallel to the shoreline and characterized by higher salinity than found in an estuary.

LAKE: a natural depression fed by one or more streams and from which a stream may flow; occurs due to widening or natural blockage of a river or stream or occurs in an isolated natural depression that is not part of a surface river or stream; usually too deep to permit the growth of rooted plants from shore to shore.

LIANA: a woody or herbaceous climbing plant--a vine--with its roots in the soil.

LITTORAL: that portion of a body of water extending from shoreline toward the middle of the water to the limit of occupancy by rooted plants.

MANUAL: a handbook used in the taxonomic identification of plant species.

MARL: a deposit of crumbly, earthy material, usually composed of clay mixed with limestone or other carbonate.

MARSH: a wetland dominated by nonwoody vegetation; if woody plants are present, they account for less than 40 percent vegetative cover.

MESIC: pertaining to a habitat characterized by a medium amount of water, neither very wet nor very dry (much vegetation adjacent to wetlands is MESOPHYTIC in nature).

MUCK: a type of surface deposit in a poorly drained area, consisting of much dark, partially decomposed organic matter intermixed with mineral matter.

MUDFLATS: an area usually supporting only sparse vegetation or no vegetation at all, although algae may be numerous on such sites; mudflats may be intertidal in coastal areas or associated with areas of widely fluctuating water levels inland.

MUSKEG: a term used in several different ways but usually referring to bog (in itself a poorly defined term) habitats of the far north.

NEEDLE-LEAF: a descriptive term used in referring to the usually slender, often evergreen, leaves of many gymnosperms (e.g., pine).

NONVASCULAR PLANT: referring to the simple (and usually small and inconspicuous) plants characterized by a lack of specialized conducting and supporting tissues (e.g., algae).

NONWOODY: referring to a plant that does not form long-lived above ground structures; plants other than trees and shrubs.

OPEN WATER: areas that support very little vegetative cover (25 percent or less); such areas comprise the permanent or semipermanent interior portions of many ponds and lakes.

OXBOW: a shallow, crescent-shaped lake that results when loops of a meandering stream are cut off; oxbows are very common in deltaic regions.

PEAT: a dark-brown or black substrate produced by the partial decomposition and disintegration of mosses, sedges, trees, and other

plants growing in areas of its deposition; peat characteristically is deposited in certain wetland types.

PERCHED WETLANDS: wetlands located away from significant stream influence; perched wetlands include potholes and many so-called bogs, swamps, and similar areas vegetated by marsh or swamp plants.

PERENNIAL: a woody or herbaceous plant living from year to year, normally not dying after once flowering.

PERIPHYTON: algae growing attached to rocks and vegetation.

PERMANENT: used in reference to bodies of water that are long persistent and not subject to the normal processes of drying out by evaporative forces.

PHREATOPHYTE: a plant that has roots extending into the water table, thereby attaining a permanent water supply; of major concern in arid areas.

PHYSIOGNOMY: a descriptive concept based on the external appearance of vegetation (e.g., forest, prairie, marsh, etc.).

PHYTOPLANKTON: small, free-floating or weakly swimming algae, restricted to the very upper levels of bodies of water.

PLAYA LAKE: a slight depression in the plains of the Interior region, containing water after heavy rains but dry at other times, often supporting distinctive vegetation.

PNEUMATOPHORE: slender conical roots that grow vertically out of the mud, found in certain types of mangroves; used in conduction of oxygen to underground root systems.

POCOSIN: a regional term applied in the Carolinas to upland bogs found in undrained, shallow depressions in pine savannahs; pocosins are dominated by evergreen shrub species.

POND: a small, quiet body of standing water, usually sufficiently shallow to permit the potential growth of rooted plants from shore to shore.

POTHOLES: wetlands occupying basins formed by melting of isolated chunks of buried ice left behind by receding glaciers.

PRODUCTIVITY: the rate at which energy is stored in the form of organic substances, which can be used as food materials.

RESERVOIR: a pond or lake build for storage of water, usually by construction of a dam across a stream or river.

RHIZOME: an underground stem, growing horizontally, often thickened and containing accumulations of reserve food material; important structure for vegetative reproduction in many wetland plant species.

RIPARIAN: pertaining to vegetation of a riverbank or streamside.

SALINA: the term used for coastal flat (salt flat) in Puerto Rico.

SALINE: referring to water having too much salinity to be considered fresh water (in common usage the term is applied to water of high salinity, i.e., in excess of 30 ppt).

SALINE FLAT: wetlands having 25 percent or less vegetative cover that are occasionally or regularly flooded by saline water or nontidal origin (e.g., salt flats in interior of U. S.).

SALINE WATER: water containing greater than 30 ppt (o/oo) salinity.

SALINITY: pertaining to the percentage of salt found in saline water.

SALT FLAT: any area having high concentrations of soil salinity and supporting little or no vegetation, may be either coastal or inland.

SALT WATER: water containing high concentrations of salinity; normally the term is used to refer to sea water.

SALTWATER AQUATIC WETLAND: a wetland that is dominated by free-floating rooted, or otherwise attached herbaceous plants (including macroscopic marine algae) and that are permanently flooded by saline or brackish water (e.g., seagrass beds).

SALTWATER MARSH: a wetland having saline (including brackish) soils with 40 percent or less cover by woody plants and 25 percent or more cover by terrestrial herbs that is occasionally or regularly flooded by brackish or saline water (e.g., smooth cordgrass marshes).

SALTWATER SWAMP: a wetland having saline (including brackish) soils with 40 percent or more cover by woody plants and occasionally or regularly flooded by brackish or saline water (e.g., mangrove swamps).

SANDBAR: a bar or low ridge of sand bordering the shore or near the surface of the water, built up by currents or wave action.

SEAGRASS BEDS: usually areas of shallow water located along the coastline that support the underwater growth of seagrasses; of great value in providing cover for spawning fish and for their great productivity.

SEAWEED: any of the various macroscopic forms of marine algae (either Red algae, Brown algae, or Green algae).

SEDGE: any member of the plant family Cyperaceae; often used to refer to the specific genus *Carex* of the Cyperaceae.

SEMIPERMANENT: referring to a body of water that under normal circumstances is long persisting but under certain conditions may dry up in response to the normal processes of evaporation.

SHALLOWS: wetlands that are not usually considered marsh; represented by shallow pools, salt pans that hold water, and shallow lakes in estuarine systems; they may be nonvegetated or vegetated with emergent or submergent vascular plants or algae.

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SHRUB: a perennial woody plant of relatively low stature (usually considered less than 20 ft) with several to many stems from at or near the ground.

SHRUB BOG: any permanently waterlogged peatland dominated by shrubs.

SINKHOLE: a characteristic feature of karst topography in limestone areas; a depression or "sink" occurs when the underlying limestone is eroded through solution processes; the sinkhole may or may not hold water.

SLOUGH: a channel of slow-moving water in a region having little topographic relief.

SOUND: a wide channel or strait connecting two large bodies of water or separating an island from the mainland.

SPECIES: a taxonomic category below the rank of genus representing a group of closely-related individuals that actually or potentially interbreed (e.g., the genus *Typha* contains several species of Cattail: *T. latifolia*, *T. angustifolia*, and *T. domingensis*; the species are considered to be closely related and hybridization is common in Cattails).

SPECIFIC EPITHET: the term referring to the scientific name applied to each species within a genus (e.g., *latifolia* is the specific epithet of the species *Typha latifolia*).

STAND: a group of plants on a given sample area.

STRAND VEGETATION: a term defined in several different ways, usually referring to the vegetation at the very edge of the shore (exclusive of any adjacent areas, such as dunes).

STREAM: any mass of water with a unidirectional flow.

SUBMERGED: referring to a hydrophytic plant that grows characteristically completely under water.

SUBMERGENT: same as SUBMERGED.

SUBMERSED: same as SUBMERGED.

SUCCESSION: the gradual, usually orderly and sometimes predictable sequence of plant communities occupying a given area with the passage of time.

SUCCULENT: a plant having juicy and fleshy stems and leaves that are adapted for water storage.

SWAMP: a wetland in which the dominant vegetation consists of trees (greater than 40 percent cover), tidal or nontidal, saltwater or freshwater.

TIDAL: referring to the alternate rise and fall of waters along the coast or of those having coastal influence.

TIDAL CREEK: a wetland situated along channels where water flows in both directions due to tidal influence.

TRANSITION ZONE: also referred to as ECOTONE; the intermediate zone between two or more adjacent plant communities, usually containing species from each of the adjacent vegetation types.

TREE: a perennial woody plant usually having a single trunk or stem and usually more than 6 m in height.

TUNDRA: a treeless plain, either wetland or "dry," found between the northern limits of trees and the region of perpetual ice and snow in the far north, or above treeline in the high mountains.

UPLANDS: areas that are not flooded on a regular basis and that do not support vegetation dominated by hydrophytes.

VASCULAR PLANT: referring to any of the many kinds of plants having specialized conducting and supporting tissue as well as differentiation into the structures known as roots, stems, and leaves (e.g., trees and shrubs of all kinds, grasses, etc.).

VEGETATIVE COVER: a term used in quantitative vegetation sampling, referring to the amount (percent) of ground with vegetation above it; estimated by vertically projecting the outline of leaves onto the ground.

VEGETATIVE REPRODUCTION: in seed plants, referring to reproduction by any of several means other than by seeds (e.g., underground rhizome systems, formation of roots on detached stems and leaves, etc.).

VERNAL POOL: a regional term applied to depressions in the grassland area of California; these pools, supporting a distinctive assemblage of plant species, fill with water in winter but dry up by summer.

WATER TABLE: the surface of the water-saturated zone of permeable rocks.

WETLANDS: those areas that are inundated or saturated by ground or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

WET MEADOWS: graminoid-dominated marshes, often with a wide variety of associated species, often found along floodplains where freshwater swamps have been cleared.

WILLOW HEAD: willow-dominated freshwater swamp occurring in southern Florida.

XERIC: pertaining to an area or habitat having a very low or inadequate moisture supply; plants of such habitats are XEROPHYTIC.

APPENDIX C: INTERPRETATION OF WETLAND DEFINITION

1. An area of some concern with respect to policy in the interpretation of the wetland definition is inclusion of the littoral zone as a wetland. In bodies of fresh water, the littoral zone is that area extending from the shoreline into the water to the limits of occupancy by rooted plants. The littoral zone has been defined in several ways by various marine science disciplines but usually is used as more-or-less synonymous with the intertidal zone (that region between high and low tides). Most intertidal littoral habitats (such as marine seagrass beds, macrophytic algal beds, rocky shores, and flats; as well as freshwater habitats such as mud flats and submerged aquatic plant beds) were regulated prior to the Federal Water Pollution Control Act Amendments of 1972, in large part by Sections 9 and 10 of the River and Harbor Act of 1899.

2. The emphasis in this report is on plant communities and their transition zones, and, from a technical standpoint, it is unrealistic to exclude the littoral zone plant communities from technical consideration. The reason for this is that plant communities are dynamic entities that are subject to considerable variation with respect to their position along various environmental gradients, and thus cannot be delineated precisely by policy statements that fail to take field realities into account. Seagrass beds, for example, usually are considered permanently inundated habitats; den Hartog,* however, reports that of the 12 genera of seagrasses, only three (none of which occur in American waters) occur exclusively in permanently flooded habitats.

3. For technical purposes, therefore, a broad definition of wetland has been followed in this guidebook series; although for purposes of practical delineation of wetlands from a standpoint of policy regulatory functions, personnel may find it necessary to follow a narrower definition.

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* C. den Hartog. 1977. Structure, function, and classification in seagrass communities. in C. McRoy and C. Helfferich, eds. Seagrass ecosystems. Marcel Dekker, Inc., New York.